CULTIVATION OF THE CHINCHONAS

GORKOM

00054957

633.88094
Gor/Cul
54957

NOT TO BE ISSUED
OUT OF THE LIBRARY.

BOMBAY BRANCH
OF THE
ROYAL ASIATIC SOCIETY.
TOWN HALL, BOMBAY.

Digitized with financial assistance from the
Government of Maharashtra
on 18 July, 2018

THE

CULTIVATION OF THE CHINCHONAS

OR

PERUVIAN BARK TREES

IN

J A V A.

BY

K. W. VAN GORKOM,

SUPERINTENDENT OF THE PLANTATIONS.

(WITH NOTES BY C. HASSKARL.)

Translated from the German.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1870.

Origin of the transmission of the Chinchona tree from South America 4
Countries where the tree is indigenous - - - - 10
The various kinds cultivated in Java - - - - 11
Elevation (above the level of the sea) at which the tree should be planted - - - - - - - 15
Nature of the soil - - - - - - - 17
Preparatory cultivation of the soil. Laying out the plantations - 19
Distance between the plants. Treatment of the plantations - 22
Mode of multiplying the plants - - - - - 28
Utility and product of the cutivation of the Chinchona - - 36
Concluding observations - - - - - - 46
Books relating to the cultivation of the Chinchona - - - 48
SUPPLEMENT - - - - - - - 50
TABLE A.—Statistics of the cultivation in Java - - - 59
TABLE B.—Comparative growth of the plants reared on new principles in the plantations - - - - 60
TABLE C.—Results of the chemical analyses of various sorts of quinine barks by chemists in Java and in Holland - 61

00054957

THE CULTIVATION OF THE CHINCHONAS IN JAVA.

It was originally my intention to compile a manual for the cultivation of the Chinchona, but, on further consideration, I found how bootless and presumptuous such an attempt would be. A work of that kind should embody instructions of a practical nature, based on admitted facts, but my own experiments were of too limited a character to admit of the deduction of established rules.

The regular cultivation of the Chinchona dates from too recent a period, and is too circumscribed to allow me to indulge in the hope that I had studied its nature to anything like a general extent. Moreover, certain external appearances seemed self-contradictory, and not in harmony with my own observations, whilst circumstances did not afford the opportunity of extending those observations in all possible directions. However, I could not allow my judgment to be warped, either by pre-conceived opinions or by disappointed expectations, and, whatever my deficiency in exact knowledge of the subject, I did not feel justified in withholding from publication such remarks as might tend to general information, and to the further elucidation of some important questions. There was, however, another inducement to proceed with the work. So far back as the year 1858, JUNGHUHN* had published a preparatory guide

* The first seeds and plants of the Chinchona were entrusted to the care of TEYSMANN, and afterwards to HASSKARL, after his arrival in Java from America, in December 1854, when he was commissioned to manage the plantations in question. On account of the illness of the latter, and of his departure from Java, the management was transferred to JUNGHUHN, on whose death, in March, 1864, the writer of this book was temporarily, and in August of the above year, definitively appointed manager,

for the cultivation of the Chinchona; but, on further examination, and after more mature experience, that work proved to be of little practical utility, so that a more exact and detailed one became a desideratum, particularly as, through the liberality of the Government, the landowners of Dutch India were afforded the opportunity of rearing the tree in question, on their own account. In order to form a due estimate of the nature and object of the cultivation of the Chinchona in Java, it may be advisable to enter into a few historical details respecting it.

Occasion of the Introduction of the Chinchona into Java from South America.

It is stated, by Ruiz, that the febrifugal power of quinine was known in Loxa so far back as the year 1636.* The Corregidor, Juan Lopez de Cañizares, obtained from the Indians his knowledge of this bark, and in 1638 successfully administered it to the Countess of Chinchon, the wife of Don Geromino Fernandez de Cabrera Bobadilla y Mendoza, Count of Chinchon. This wondrous powder, which so surely and so speedily drove away the much-dreaded intermittent fever, that so obstinately resisted all other medicines, acquired thereby the name of *Pulvis Comitissæ* (the Countess's powder). It was frequently sent to Europe, where it became known as the *Pulvis Jesuiticus*, and as the *Medicamentum Talborii* or *Anglicum*.† For a long time it was worth its weight in silver.‡

---

* See Weddell's *Histoire Naturelle des Quinquinas*, p. 15. Von Bergen (*Versuch einer Monographie der China*, p. 84), gives the date as 1632. See also Von Humboldt's "Ansichten der Natur," ii. 317 and 390.—C. Hasskarl.

† Rhode, *Monographiæ Chinchonæ generis tentamen*, p. 6, in which the bark is also called *Cortex Jesuiticus*, or *Pulvis Patrum*, as well as *Pulvis Cardinalis*, because the Jesuit Father de Lugo, afterwards Cardinal, brought it to Rome. —C. H.

‡ Petersen, *Dissert. de Cortica Peruvianâ*, p. 3, says, "Hi (Jesuitæ) ipsum "postea in Italiâ, formâ pulveris et nomine Cardinalis de Lugo, contra idem "*auri* pendus vendiderunt." (They (the Jesuits) afterwards sold it in Italy, for its weight in gold, in the form of a powder, and under the name of the Cardinal de Lugo's powder).—C. H.

Linnæus called the tree which produced this bark "Chinchona officinalis." Condamine, who, in 1737–38, made a scientific tour through a portion of South America, described it first as *Quinquina de Uritusinga* (*Quina Primitiva*), and at a later period Humboldt and Bonpland made use of the term *Chinchona Condaminea*. Once the efficacy and the origin of this bark had become known in Europe, it did not escape the attention of traders and pharmacologists, and when, subsequently, several botanists began to treat of the tree itself, the confused notions as to quinology increased in proportion to the number of quinologists. Envy and vanity became more visibly developed, and soon the mystifications of commerce made matters all the worse.

"Whilst, on one side, unscrupulous botanists designedly confused the knowledge of the species, pharmacologists, on the other, included in the imperfectly known and described species of the former, the various "fever-barks" introduced into commerce under different names, taking for granted that the barks of all Chinchonas would form articles of trade." (Karsten's *Medic. Chinarinden*, New Granada's, p. 5).

"Commercial cunning was carried to such an extreme that, by Royal order, a quantity of the highly excellent orange-coloured quinine of New Granada, which, at the expense of the Sovereign of Spain, had been peeled off by Mutis, was burned in Cadiz as a wholly useless remedy, at a time, too, when in all the field hospitals, this costly produce of South America was very scarce. A portion of the condemned quinine was secretly purchased by English merchants in the above city, and sold at high prices in London." (*See* Bergen, *Monogr.*, p. 115, as quoted by Von Humboldt; also the article on South American Chinchona forests in the "Magazin der Ger. naturforsch. Freunde," Berlin, i., 1807, p. 59, and the "Quinologie" of Delondre and Bouchardat, p. 11.)

We are indisputably and mainly indebted for the most complete history of the subject to WEDDELL, who, in

1845-8, visited the countries where the tree is indigenous, and who is still, thanks to his zealous and cordially undertaken researches, one of the best authorities. He, too, censures the reckless manner in which the primitive Chinchona forests have been ransacked, to no useful purpose; and, like many others before him, expresses the apprehension that, unless the practice be discontinued, a scarcity of quinine will inevitably ensue. He then (*Hist.* l. c. p. 13) continues as follows:—"The only remedy is cultivation, "and it is absolutely necessary to have recourse to it. If "any tree deserve acclimatization in a French colony, that "tree is incontestably the Chinchona, and posterity will "invoke a blessing on the man who has carried the idea "into execution." Messrs. Jussieu, Richard, and Gaudichant, in their report on the above-quoted work of Weddell, addressed to the French Academy, of which they were members, add the following remarks:—"We cannot "do otherwise than recommend such an attempt, and it is "for the Government to undertake the matter in question. "Although it may not be perfectly known how many "years would be required for bringing the bark to a "proper development, or how many for rendering it in the "highest degree productive, it is certain, at least, that a "somewhat considerable time would be necessary. It "may be said, therefore, that the returns are too uncer- "tain and too slow to offer any inducement to private "industry." *

The first endeavours of any importance on the part of the French Government to secure to their colonies the pos-

---

* Some years later, after the successful introduction of the Chinchona into Java, Delondre and Bouchardat (*Quinolog.*, p. 15) wrote as follows:—"Some "parties have conceived the idea of acclimatizing the *Chinchona* in other "countries, *but, unfortunately, this does not appear to us to be possible*, for "nowhere else is to be found any soil like that of the forests which extend "along the chain of the Andes. On the other hand, it would be a matter of "no difficulty to make such arrangements, in respect of those forests, as would "prevent the destruction of so many of them, and, at the same time, facilitate "reproduction."—C. H.

session of this valuable tree date from the year 1850, when seed, brought direct from South America, was introduced into Algiers. It then became the general belief that the Dutch possessions in the East Indies would afford a better prospect for the acclimatization in question; and it was confidently hoped that, in the general interests of humanity, the attempt would be powerfully supported and encouraged. In the year 1851 De Vriese exchanged in Paris a genuine *Calisaya Chinchona* for some Indian plants, the former having been reared by Messrs. Thibaut and Keteler, of that city, from seed gathered by Weddell. This Calisaya was sent to Java, where it arrived in April 1852, but it shortly afterwards died in the Botanic Garden at Buitenzorg; not, however, before Teysmann had succeeded in cutting a sapling, which is now a well-grown tree at Tjiboddas. This tree, one of the best species, was the mother plant of a numerous progeny.

Already in 1829 various Dutch authorities on the subject, such as Reinwardt, Blume, Korthals, Mulder, De Vriese, Miquel, and Junghuhn had pointed out to their Government the desirability of introducing into Java the cultivation of the Chinchona; and at the suggestion of Mulder a commission was drawn up for Textor to proceed to America, but the unexpected death of the latter put an end to the undertaking. When, after Weddell's memorable journey, and in consequence of the information derived from the facts he brought to light, the general attention of the civilized world was attracted to the Chinchona trees; when, too, the experiments of the French Government had proved fruitless in Algiers; and when fresh attempts were expected to be made on the part of the Netherlands,—it could be no matter of surprise to learn that decided measures were at last taken to introduce the Chinchona into Java direct from South America.

This historical occurrence is amply and spiritedly described in De Vriese's opusculum, intituled "De Kinaboom "uit Zuid-Amerika overgebragt naar Java" (the Quinine

tree brought from South America to Java.*) It is scarcely necessary to mention here that the grand plans and projects which were matured under the Minister of State, Pahud, were both zealously and perseveringly carried out by Hasskarl; and when we now take into consideration all that has been since done in Java in the furtherance of various ideas and principles we can only regret that the work was not continued on the basis laid down by Teysmann and Hasskarl. Had that been done we are justified in believing that the cultivation would have already proved productive.

Nevertheless Junghuhn cannot be reproached for adhering to other principles perhaps too strictly, but no *à priori* judgment could be possibly arrived at. In any case he needed all his knowledge of the subject, and all his energy, to point out in Java so admirably adapted a site for the cultivation of Chinchona as the one which he made use of for that purpose, for nowhere else in that island was to be found so suitable, so fruitful, and at the same time so extensive a tract. It may be added here, that when Anderson examined the spot in 1861 he expressed himself warmly respecting the principles on which Junghuhn had acted, but that at a later period the former altered his opinion, and planted the Chinchona in the Presidency of Bengal, as Hasskarl and Teysmann had previously done in Java, McIvor in the Presidency of Madras, and Thwaites in Ceylon.

The necessity for attempting the acclimatization of the Chinchona in Java becomes now apparent. Such persons as are not yet convinced on that point should recal to mind

---

* Discovered by Mulder amidst the dust of the archives.—H. K. This little work, which, so far as the subject of the introduction of the trees is concerned, is for the most part taken from my official correspondence with the Dutch Colonial Minister, was published in Holland, without my knowledge or co-operation, in the year 1855, whilst I was engaged with the cultivation in Java. I was all the more induced to remain silent on that point that all my further observations, contained in letters to my wife, for the purpose of being afterwards turned to account, were lost in the catastrophe of December 4, 1854.—C. H.

the names of their countrymen and others who, for more than thirty years, have been urging their respective Governments to undertake the work, and whose well-meant suggestions have, fortunately not been left unheeded. As for those individuals who oppose all kinds of objections on the score of the difficulty to be encountered, it would be useless to adduce any further proofs. We now proceed with our task.

Let no one rest satisfied with the idea that substitutes can be found for quinine, and that it would therefore be folly to employ so much labour and so much money in the cultivation of the tree which produces it. Those substitutes have not yet made their appearance, and the efforts of chemists in that direction have not led to any encouraging results.* In any case it would be difficult to find a better febrifuge than the one in question, and moreover it is doubtful whether any more effective one can be so easily and so generally obtained.

Neither would it be reasonable to dispute the urgency of the undertaking on the plea that there is as yet no sign of any decline in the quinine trade, and that there is rather a fall than a rise in prices. Quinine was first prepared in the year 1820 by Pelletier and Caventou,† and since then scientific men have succeeded in effecting that operation with less waste, so that much that was formerly thrown away is now turned to profitable account.

It is still impossible to gainsay, with any show of justice, what Weddell in his History (c. i., p. 13) has stated with regard to the reckless working of the Chinchona forests in

---

* Whilst still residing in Java I was informed in a letter from Berlin that a skilful chemist of that city was desirous of congratulating me on my introduction of the Chinchona, but that he regretted to have to state that he was engaged in preparing quinine by a chemical process; so that, so far, my labours were to no purpose. Fourteen years have elapsed since then, and nothing has come of his experiments in that way.—C. H.

† Annales de Chimie et de Phys., 1820, tome xv., p. 289 ff., and p. 337; Trommsdf. Journ., 1822, vi. 1. pp. 5–82.

America. His words are these:—"If no means be adopted "to arrest this destroying agency posterity will have to "regret, if not the total disappearance, at least the gra- "dually occurring scarcity of the various kinds of quina." In the year 1846–7 Delondre, one of the first of connoisseurs and traders, with respect to that article, undertook a journey to America in order to negotiate the regular transmission, for the first time, of good Chinchona barks; and he, too, soon perceived in what a deplorable way the valuable trees were treated: "On ascending the mountains I could not "fail to observe with regret with what recklessness the "Indians, in order to avoid stooping, struck their axes "into the trees high up the trunks. This occurs in all the "forests of South America, the Indians making use of the "trunk only up to the part where the boughs take their "rise.* The result is that scarcely one half of the bark is "collected. Even if there be no decline as yet in the "quina trade, still there will spring up, every year, a "larger and more general demand, and we shall be com- "pelled to make use of those inferior kinds which hitherto "have not been held in sufficient estimation to form "articles of trade." (Delondre and Bouchardat, *Quinologie*, p. 21.)

Origin of the Quina Trees.

These trees are indigenous to the tropical portions of South America, making their appearance everywhere along the eastern declivity of the Cordilleras between 10° N. latitude and 19° S. latitude. The western portion of this curved line lies near Loxa, in 82° 43′ W. longitude, par., the southern frontier approaches to 62°, and the northern to 70° W. longitude, par., but the Chinchona zone is limited

---

* This statement would appear to be contradicted by the not unimportant quantity of "canutos" and "écorces roulées" introduced into commercial dealings, and which Delondre and Bouchardat themselves (p. 25) take to be the produce of the young boughs.

to the height of 1200–3270 mètres above the sea. The tree is seldom found in massy groups,* but generally only in small ones or apart, or scattered amongst the other forest productions. It cannot withstand the extremes of heat and cold, such as occur respectively in lowlands and highlands.

There are more than 20 genuine sorts of quina trees, the most important, in our opinion, being the *C. Calisaya*, the *C. Condaminea*, *C. succirubra*, and the *C. lancifolia* (var. *C. Condamineæ ?*). The majority of those kinds in America grow up large and splendid forest trees, but all recent travellers now agree in stating that at present they are seldom found of the traditional dimensions, and that the "Cascarilleros" (bark gatherers) are now content with trees from 9 to 30 ft. in height. I. von Warszewicz, inspector of the Botanical Gardens at Warsaw,† who appears to have made important researches in America, states that he was eight days in a forest before he met with any *C. Calisaya* of even 50 to 60 feet in height. With regard to the *C. Condaminea*, he expresses the opinion that that species can be most profitably reared by cutting two to three year old plants, some four or five feet above the ground, a process which makes them shoot out again strong, producing generally six to eight young shrubs, susceptible of being removed in the third year and peeled. He does not fail to remark that the nature of the site considerably influences the growth, so much so, indeed, that in open disforested places only shrub-like trees are to be met with.

Chinchona Species, cultivated in Java.

We have already described the original countries of our oldest *C. Calisaya* plants, and Hasskarl also brought this species with him on returning from his mission, but in the

---

* Like the *C. Calisaya* in Bolivia. Weddell.—C. H.

† Died on the 26th of December 1866.—C. H.

course of the last three years large quantities of seeds have also been forwarded direct to Java from South America and from Ootacamund. The *C. succirubra*, which is here cultivated, has sprung from seed collected by Hasskarl in South America, but also, for the most part, from the eleven plants given by the English Government in the year 1862, and seed has also been sent here during the last two years from India. Thanks to the Dutch Consul in Caraccas, Mr. Roldanus, some seeds of this kind have also arrived from New Granada, and with the above-mentioned eleven plants came likewise a *C. micrantha*, from which seeds were despatched a few months ago. In the year 1865 British India contributed some plants, and subsequently a quantity of seeds of the *C. Condaminea*. The *C. lancifolia* trees were the production of seeds which had been collected by Karsten in New Granada, and presented by him to the Dutch Government through the Governor of Surinam. Finally mention must be here made of the *C. Pahudiana* and the *C. lanceolata*, which may be set down as identical, and which were derived from seeds to which Hasskarl had devoted his attention.*

The *C. Pahudiana*, before its introduction into Java, seems to have escaped the attention of quinologists. At first it was taken to be the *C. Condaminea*, and afterwards the *C. ovata* or the *C. lucumæfolia*,† until Howard described it as a separate kind, and, as a fitting tribute of respect, gave it the name of the statesman who may be claimed as the originator of the Chinchona cultivation in the above island. For some years the mercantile value of the *C. Pahudiana* formed a subject of dispute, but it would

---

* Hasskarl forwarded from America the seeds of various kinds of Chinchonas. Those seeds were sown in the Dutch Botanical Gardens, and the young plants shipped at various times to Java, where they were attended to by Teysmann, at Tjiboddas. In December 1854 Hasskarl himself came to Java direct from America, bringing with him 89 live plants.

† Miquel regards it as a variety of the *C. Caravayensis*, Wedd. *See* Miq. Guide, 1868, p. 247. Flora (B. Z.), 1868, p. 453.—C. H.

appear to be recently acknowledged in London.* The species, however, is relatively of little value, and the cultivation is no longer particularly attended to.

There are at least six sorts of Chinchona under cultivation in Java, together with several varieties of the *C. Calisaya, C. succirubra,* and *C. Condaminea.* Dried samples have been forwarded to Professor Miquel for the purpose of being subjected to thorough examination, and of being more exactly defined, as the botanical classification is too complicated and lacks authority, particularly as the organs of fructification as well as the leaves of the same kinds of Chinchona differ so materially one from the other, that the, in other respects, permanent signs of recognition assume a doubtful appearance. The chemical analyses have, meantime, proved the adaptability of the Java soil and climate to the production of the quinine barks, not inferior, so far as the healing power is concerned, to the best esteemed in commerce; in fact, trustworthy merchants in Amsterdam have pronounced a favourable opinion with reference to the barks exported from that island.

---

* "The *C. Pahudiana* bears on the label which was given me by "Hasskarl (who collected the seeds for the Dutch Government), the "Spanish name of *Crespilla chica*, the *Crespilla grande* being the *C. ovata*, "thus designating, by way of contrast, a connection between the larger "and smaller *crespillas.* This would probably account for its being taken "in Java for the *C. ovata.* So far as I may be enabled to fix its relation-"ship I should say it is the *C. rugosa*, also a *crespilla* bark (*Crespilla* of "CUENCA), to which it bears a close affinity. In its chemical characteris-"tics also it corresponds with that bark, so that it would be a pity to see "these trees disappear from Java, as they yield a bark which is as good as "that of many other kinds which are sold in London as Crown-bark, and "probably in Germany as *C. uritusinga-suberosa.*"—Howard. "Observa-"tions on the present state of our knowledge of the *genus Chinchona*, "in a report of the International Horticult. Exhibition held in London, 1866, "p. 211, f." Also Howard "On the Cultivation of the Chinchona in the East "Indies," Journal of the Linnæan Soc. x., pp. 15–18. "The analyses of "these barks show that this species is neither to be held in too little nor in "too great estimation, as has often been the case; it would appear to be "superior to the fine bark of Loxa, judging at least by the cultivation in "India."—*See* Bullet. de la Soc. de Bot. de France, XV. (Revue bibliogr.), p. 133. Miquel thinks there is scarcely any value whatever in this bark (p. 453).

On the suggestion of MR. ROYLE certain Englishmen in the year 1839 took up the question of the introduction of the Chinchona cultivation into the British colonies. In 1852, urged again by the above-named individual, the English Government made some attempts to that effect, but without any satisfactory result, until at last they sent MR. MARKHAM to America in 1859, and his zealous efforts and judicious measures were crowned with perfect success.* In the year 1853 Fortune brought some Calisaya plants to the Himalaya Mountains, but subsequently to 1859 MARKHAM, assisted by SPRUCE, CROSS, and PRITCHETT, richly endowed the colony not only with plants but also with seeds of the various kinds. Since then the English cultivation under MacIvor, Anderson, and Thwaites attained such a degree of prosperous development in Madras, Bengal, and Ceylon, that they were enabled to induce the majority of the landowners to raise plantations on their own account. It is clear, therefore, that British India is in advance, but, if we may enter on any comparisons, it would be only fair to remark that the example was set by the Netherlands, and that the experience of the latter country was, naturally enough, turned to account, so that certain mistakes, which arrested the progress of the cultivation in Java were avoided in British India. On the other hand, although the English obtained from that Dutch island both seeds and plants for their own possessions, the foregoing details show that it would be altogether a perversion of facts to affect to declare that England is indebted to Holland for the Chinchona trees which now flourish in British India. There were reciprocal exchanges and acts of good will in the way of mutual assistance, from which, however, on this side not the slightest benefit was derived.

---

* The Jury of the Paris Universal Exhibition warmly recognized the services so successfully rendered by the introduction of the quinine plants into British India and the Mauritius, awarding the silver medal of the 1st Class to MacIvor, Morin, and Vinson, and gold medals to Markham and Hasskarl. Had Junghuhn been still living, the Jury would have forwarded to him the silver medal of the 1st Class.

Of late years, the French Government have bestirred themselves with respect to the propagation in their colonies of the quinine trees, and to that effect have frequently made application for plants and seeds. It may be stated here, that English aid has not been wanting towards the attainment of that object, but nothing positive as yet can be said as to the results. It may be added that more than one collection of plants from Java reached their place of destination, in perfect condition, and quite recently two cases of plants with several thousands of seeds were forwarded to the Paris Acclimatisation Society, through the French Consul General in Batavia, M. Duchesne de Bellecourt. This society, with the active co-operation of its distinguished president, M. Drouyn de Lhuys, endeavoured to acclimatize the Chinchona in the southern parts of Europe. In the year 1861, it offered a prize of 1,500 francs for that purpose, and the appeal—a never failing one—to the good will of the Dutch Government was followed by the transmission of the plants and seeds recently referred to. Satisfactory intelligence has been lately received with regard to the plants which were forwarded to Brisbane in Australia. As for those which Portugal* and the Sandwich Islands received from the Government of the Netherlands, we do not know as yet how they have prospered.

After this cursory glance at the cultivation of the quinine trees, we may now proceed to certain suggestions and rules respecting them.

Elevation at which the Chinchonas are to be Planted.

As regards certain narrow limits, it would appear that the growth of the Chinchona depends more upon the nature of the soil, the site, and the evenness of temperature than on the elevation above the level of the sea. In general, however, the condition of the plantations tends to show

---

* "There is now a prospect of success with reference to the cultivation of "the Chinchonas in the valley of Orotava, in the island of Teneriffe."—Flora (*Botanical Gazette*), 1808, p. 448.

that an elevation of 1,600 mètres, at a temperature of 17° C., is the most suitable one for Java. At Lembang, the trees grow—and not unfavourably—at 1,254 mètres, but the question arises as to whether they will spring up on that site to large trees. Apparently, they will attain their full growth in a few years, and if so they will have to be cut down for fire-wood, or farm house timber. It is true that on the Malawa and Ajang Mountains, the Chinchona plantations have all the appearance of becoming powerful trees, the elevation being 2,250 mètres, and the mean temperature 14–15° C., but such elevations present difficulties which are scarcely counterbalanced by the probable advantages. Meanwhile, and until more exact information is obtainable, it may be safely assumed that the trees should be planted at the height of about 1,600 mètres, at a mean temperature of 17° C., and that the lowest limits of cultivation are to be fixed at from 1,200 to 1,900 mètres, at a temperature ranging from 20° to 15° centigrade. This assumption, however, does not by any means imply that no attempts at cultivation should be made beyond such limits. The difference of a few mètres, one way or the other, will not jeopardize the plants, and it must not be forgotten that climate and temperature are not exclusively dependent on the elevation above the level of the sea, inasmuch as the properties of the soil exert considerable influence.

Wherever with reference to proposed new plantations, there is a deficiency of exact data as to height, and the degree of heat, approximate results—applicable for the object in view—may be obtained through barometrical and thermometrical observations. According to general opinion, the mean temperature of any place coincides with the steady or regular heat of the soil, and, in tropical countries, that heat can be determined, as a rule, at the depth of five feet below the surface of the earth. It may be stated here, however, that according to several travellers, each of the various species of Chinchonas requires a certain height for its development; but the results of the experiments here would not justify the unconditional acceptance of such an

opinion. In any case, it has been already observed that the *C. Condaminea* flourishes best in elevated plantations. It may also be taken for granted that, in proportion to the progress of acclimatization, and the rearing of plants from seeds obtained here, the sensitiveness with regard to climate and soil will diminish. As for the influence exercised by differences of elevation, on the increase or decrease of the alkaloids of the barks, that is a question which cannot as yet be exactly determined, for want of sufficient experience on the subject (see Table C.).

Nature of the Soil.

If, in general, it be a difficult and hazardous matter to express an opinion as to the most suitable soil for any particular kind of cultivation, it is more especially necessary to be cautious with reference to the Chinchona trees, as positive data are wanting in that respect. Markham (in his "Travels in Peru and India," p. 260) makes the following remarks:—"The Calisaya plants all grew amidst moss, "which together with *Hymenophylla*, covered the rocks to "the depth of from 8 to 12 inches. Scarcely any soil was "to be found underneath them. The roots spread over the "surface of the rock, which is composed of metamorphic "clay, slate, without any fossils, but somewhat micaceous "and ferruginous, and which, in some detached parts, is "easily broken through by the protruding roots. This was "the position in which we found the *C. Calisaya* more "frequently than in any other we had previously seen."

Up to that time, experience did not show that the *C. Calisaya* was particularly sensitive as to the nature of the soil, and, in point of fact, its main root appeared to adapt itself well enough to surrounding circumstances. On the other hand, Von Warszewicz declares that the *C. Calisaya* requires a loamy soil, and that the *C. Condaminea* grows in moist, turfy, black earth, like our common alder trees, which, it is well known, flourish most under such conditions. Weddell, too, has the following observations:—"The soil in which the *C. Calisaya* generally makes its

" appearance is tolerably similar to that which is termed " *terre franche.* It is true that this soil is constantly being " formed out of the large quantity of humus on its surface, " but that vegetable earth is washed off by the torrents of " rain which, for several months every year, descend from " the mountain declivities."

Be all this as it may, it boots but little to know in what sorts of soil the Chinchonas grow in America, as we must remain content with such soil as Java affords. Even a knowledge of the chemical properties of the ground may be dispensed with, for when and where has any practical agriculturist in Java postponed his labours until he had procured an analysis of the ground he was about to cultivate? One thing too is certain, viz., that in every kind of soil fit for purposes of cultivation, the like component parts exist, whatever difference there may be with respect to the relative quantity of such parts. Whatever, as a rule, should be possessed by the soil is notwithstanding here.

The first question to be asked by any one undertaking to plant Chinchonas is this:—Is there sufficient ground at a suitable elevation? The next point will be to ascertain the physical properties of the soil, and, in that respect, it may be assumed that a mixture of rich humus-sand and loam is the most advantageous. If one be free to make a choice, let the preference be given to forest land, avoiding, on the one hand, steep declivities, and on the other, too extensive plains; and taking care that the ground be not such as may be washed away, and yet that it be capable of receiving proper drainage. Nothing positive can be said as to which is the best adapted land, in respect of the direction of the wind, for the growth of the trees, and particularly for the development of their alkaloid substances; there can be no doubt, however, but that such places as are greatly exposed to violent currents of air are unfavourably situated.

It so happens that the personal experiences of KARSTEN and MARKHAM are not unfrequently at variance; the former says that such Chinchonas as are rich in alkaloids

grow in high, moist, and dark woods, and are constantly covered with blossoms and fruit (Medicinal Barks of New Granada, pp. 12, 15); whereas MARKHAM (Travels in Peru and India, p. 501) states that, although some kinds do grow in sombre and moist tracts, they do not blossom there, unless there be a free current of air and light. According to KARSTEN, the quantity of alkaloid in barks of the same species varies considerably, and is wholly dependent on climatic circumstances, and the properties of the soil.

PREPARATION OF THE SOIL. LAYING OUT PLANTATIONS.

If Chinchonas be planted in thick umbrageous sites, their growth is but slow, and they have but a poor appearance, retaining for a long time only a feeble exterior, and not forming bark of any thickness, whereas a good size is the main object of cultivation. This is a fact universally and regularly recognized in Java, and one that deserves special mention, particularly as many persons labour under the impression that such sites as those just mentioned are the most favourable for the development of alkaloids. It is true that, if time be allowed for proper growth the tree may, under such circumstances, attain a considerable height, but the experiments made in the deep primitive forests are not encouraging, in that respect. The majority of the plants there died prematurely, thus clearly demonstrating that only a few can withstand the baneful influences to which they are subjected. An excess of moisture renders the plants sickly, and the quickening rays of the sun cannot penetrate sufficiently near to them to infuse fresh vitality. Such trees as—more fortunate than the others—escape an early natural death perish later through the decline of internal power. Always pining for air, they rise higher and higher, but this violent progression upwards is at the sacrifice of the innate strength of the plant itself. Even artificial support, admitting that it can be practically afforded for any length of time, cannot compensate for the want of internal self-dependence, so

that the comparatively long but feeble trunks bend and break, either through the weight of the upper portions of the tree, or through some slight external irregularity. In cases, too, where it is deemed desirable, on theoretical grounds, to lay out a plantation in the primitive forests, so many obstacles of a technical and financial character are encountered, that the attempt is soon abandoned as one which cannot be carried out for any practical purpose, or at least as one that cannot be fairly persevered in. From the very outset, there could be no question of any regular planting, for experience also teaches that it would be utterly impossible to devote sufficient attention and care to it. To all this must be added the damage occasioned by the frequent fall of old trees and by the wild animals that haunt such forests, and it will then be seen how groundless would be all hopes of success. If, on the other hand, the cultivation take place on sites wholly exposed to the full blaze of the sun, then the plants subjected to so severe a test as that, soon show a tendency to a shrub-like development. They may, it is true, spring up quicker, and form many boughs as well as thick barks, but there would, apparently, remain but little chance of rearing them to large trees. This was also the opinion of JUNGHUHN, for he states, in his Report of the 3rd of April 1862, that, if deprived of shade the trees do not attain a greater height than 15 feet. This may, indeed, be the rule but the exceptions are numerous, for we have trees here (Java) which never enjoyed any shade whatever, and yet are 30 feet or more in height.

These two extremes naturally suggest a happy mean, and as a fundamental principle, we may take for granted that a slight shade is required, at least for the first few years, and this can be obtained by intermediate planting, for example, of such luxuriant trees as the *Erythrina* (Dadap) and the *Sponia* (Karai). If forest land is to be devoted to Chinchonas, the best way to begin is to hew down all the trees on it, for if any be left they would probably be unable in their isolated state, to resist the violence

of the winds; and if they fall they might do considerable damage. Moreover, aged trees do not afford the necessary shade, and the heavy drops of rain which, after every shower, fall from their thick-leaved boughs on the frail plants beneath them are very injurious to the latter. It will be, therefore, advisable to plant, what may be termed the sunshade trees simultaneously with, or a short time previously to, the Chinchonas, in order that both kinds may grow up together, the former being so planted as to afford also shelter against the winds. Opinions still widely differ as to the influence of light and shade on the formation of the alkaloids, and in order to acquire any certainty in that respect we must still have recourse to a variety of analyses of such barks as are well known through being regularly cultivated, that is to say, well known with reference to their origin and history.

Passing over, however, such considerations for the moment, it may be assumed from what we already know through observations in respect of soil, light, shade, and wind, that the Chinchonas are not more sensitive than the coffee tree, and that, accordingly the instructions as to the best mode of cultivating the latter may also be followed, at least in the beginning, in regard of the former, taking of course into consideration requirements of the climate. In the preparatory clearing and cultivation of the ground, so many local circumstances must be kept in view that the planter is under the necessity of seeking counsel from his own judgment and experience. Forest land is ordinarily loose enough, so that it does not need any general deep disintegration or turning up, on the other hand it must be entirely cleared, and it is desirable even to dig up the holes in which the trees have been rooted in order to be satisfied that nothing of an obstructive or deleterious nature remains in the soil. This operation has the additional advantage of substituting the upper stratum of earth for the lower ones, whereby the tender young plants are guaranteed a suitable surrounding.

The proper time for planting is undoubtedly the season

of the year preceding the rainy one. This, however, is not of so much importance in high and moist mountainous sites, if only violent and continuous rains and presistent drought can be avoided. Here in Java the plantations have hitherto been laid down without any special reference to the monsoons, that is to say, except so far as the development of the young plants may be concerned, and the results have not manifested any particularly striking or normal difference. There is in fact no sharply defined difference between dry and wet weather in the more elevated forests of that island, for when there is an intermission of rain for some time, a considerable moisture and coolness are superinduced by the damp mists that prevail in the evening and during the night. It will be necessary, however, instead of planting immediately in newly dug ground, to let it lie fallow for a little time, otherwise the plants on such virgin soil are generally much injured by vermin.

Distances between the Plants. Treatment of the Plantations.

With regard to the distances between the plants and the mode of treatment of the plantations, it will be necessary in this case also to take into consideration the nature of local circumstances, and to rely on one's own judgment and experience. A certain height is, however, attainable by the plants at whatever distance they may be placed one from the other. If that distance be but a short one they will intertwine and serve for mutual protection against heavy winds and excessive summer heat; on the other hand they will not grow up large robust trees, but assume the appearance of house timber, requiring, however, no further care and attention on the part of the planter as the soil will be two closely covered to admit of any luxuriant growth of weeds. Should greater distances be adopted then the plants will not spring up so quickly in the beginning, and there will be a sensible want of "shade trees," such as would serve also to intercept the currents of wind. It may be added here that as greater facilities are

afforded for the increase of weeds, great attention must be devoted to the plants.

We now come to the question at what age do the Chinchonas acquire their maximum supply of alkaloid? Science has not yet decided the point, but it will not seem hazardous to assert that as the formation of alkaloid is a question of time, it would be advisable to allow the trees to attain their full growth. Dr. Scherzer, the Austrian naturalist, wrote as follows to Mr. Van Schierbrand on the 21st of January 1860: "It will be satisfactory for Dr. Junghuhn and Mr. "De Vry to know that also on the West Coast of South "America, the barks of the young Chinchonas do not "contain any quinine, and that that wondrous curative "makes its appearance only in trees of from 15 to 20 years "of age."* Although the above statement does not tally with other ones, nor with the experiments which have been made here on very young barks, still it remains a significant declaration. It is possible that a close mode of planting may obstruct growth, but we must not lose sight of the concomitant advantages previously referred to, particularly as, when necessary, the plantations may be thinned for the purpose of affording more air. The foregoing observations serve as a primary basis for the following instructions.

The *C. succirubra* and *C. micrantha*, which are characterized by particularly large leaves and large wide crowns, are to be planted at 7 to 9 feet distance; on the other hand, the *C. Calisaya*, *C. lancifolia*, and *C. Pahudiana* at 5 to 6, and

---

* See also Scherzer's "Novara Reise," ii. p. 565. "Precisely at the time "I was in Java, chemical experiments were made on the barks of the young "Chinchona trees, and the fact that the invaluable alkaloid was not found "therein, awakened the apprehension that, under the altered climatic and "geognostic circumstances of their adopted country, the barks of those trees, "although the latter were reared with very great attention, were deficient in "their most valuable component parts. However, the information I was enabled "to procure in South America, tends to prove that even in those parts where "the Chinchonas are indigenous, the quinine is only met with in the barks of "the older trees, and that it increases in proportion to the growth of the trunk. "Quinine most abounds in trees of fifty years of age and upwards."—C. H.

the *C. Condaminea*, which is always smaller, at from 4 to 5 feet. The more exposed the site the greater the number of *Erythrina* and *Sponia* that should be inter-planted. Should it be subsequently found that the distance is not sufficient to admit of a robust development, some of the trees can be hewn down, and the materials thus acquired may be looked upon as a preliminary harvest. The "shade-trees" may be kept within due limits, either by cropping them or by a partial removal. Here in Java there are three year old plantations, wherein the Chinchona trees afford each other all the required shelter, so that it would appear practicable to do away altogether with those which were originally destined for the above purpose.

If it be a matter of necessity to make choice between the two extremes, that is to say, between sites closely shaded against, and others fully exposed to, the rays of the sun, preference should be given to the latter; and as much labour is involved in the operation of planting shade-trees, and of subsequently uprooting them, means have been devised for dispensing with them as much as possible. It is during the first twelve or eighteen months that shade is most required. For some short time after being placed in the open ground, the plants have a sickly appearance, the leaves begin to droop and become yellow, and even brown, and there are general symptoms of desiccation and decay; the result being that the planter is kept for months together in a state of uncertainty. Once, however, the vital power is re-animated, and the root firmly attached, the plants speedily recover, and enter on a new phase, conducing to a rapid development. Once, too, they have reached a certain height they are enabled to withstand, without any great injury, any external influences, being mutually protected by the adoption of the proper distances already specified.

The first period of debility requires, therefore, particular attention. In the year 1867, the plants were not, for the most part, supplied with shade-trees, but were protected, and successfully, by small bamboo gabions about 0·75

mètres in height, and about 0·5 mètres in diameter, easily transportable, and occasionally capable of being employed again for the like purpose. Some 20 or 25 of them can be made by one workman in a single day, out of the bamboos growing wild in the neighbouring forests. By means of these wicker baskets or gabions, even very young plants are secured against any injury from wind or heat, after having been transferred from the nursery beds to the open soil; in fact, they continue to live under the like conditions as in those beds, and at the same time enjoy the advantage of the refreshing rains. The favourable results of these attempts have led to a general adoption of the like plan in all the establishments, and since then the transplanted Chinchonas have seldom exhibited any signs of that standstill or retrogression so frequently observed before.* So soon as the plants have become sufficiently strong, these baskets may be removed and employed in some other plantation. It is possible that the nature of the soil may have contributed to the success which has been adverted to, and it will be only proper, therefore, to enter into some further details respecting that soil, so that no one may be induced to blindly follow the example that has been set.

Up to the period we are speaking of, the cultivation of the Chinchonas in Java was only carried on in remote primitive forests. A sufficient number of trees, it is true, were felled on the ground appropriated for that cultivation, but the quantity of timber strewed around was so great that no portion of the site remained uncovered; and, unfortunately, the best kind of wood could not be carried away in consequence of local difficulties, including the absence of roads. The loss, however, in that respect, was not so great as may be imagined, for only a few of the centenarian trees are of use in the manufacture of domestic articles. The entire or even

* This mode of treatment of the young Chinchona plants can also be usefully applied to the coffee plantations. The outlay is well compensated by the more rapid and robust growth of the plant, and a lesser rate of mortality. The latter circumstance ensures an economy of time, by diminishing the necessity of re-planting.

partial removal of those masses of timber can only be effected in the vicinity of ravines. When the branches are lopped off, the trunks become objects of commerce; the former are burned, and the stumps of the latter are, as much as possible, left standing in regular rows, thus dividing the ground into sections, which whilst presenting here and there many obstacles, nevertheless serve, in the beginning, as so many shelters for the interplanted trees. In the course of a few years the majority of these blocks of wood disappear, and the forest is thereby rendered still more valuable.

The supposition that this process would, if persevered in, lead to the destruction of the forest, has excited some apprehensions with regard to the climatological results.* It may be observed, however, that, in the first place, this partial disforesting is of but little importance in view of the immense tracts of wooded country still existing, and that, in the second, plantations of great utility will very shortly replace an unprofitable material. And here it may be added that the mountain tops—in other words, the sources and sites of a number of small water tributaries—escape the woodman's axe, so that both the climate and soil can only be improved by the clearances in question, provided the process of re-planting be still carried on with the like attention. In fact, experience shows that, whereas formerly, before the forests were touched, some quinine plantations had to suffer at one time from a deficiency, at another from an excess of water, there has been, during the last two years, a more equal distribution of moisture.

This circumstance is all the more important that it coincides with the observations made in British India.

---

* See Flora (B. Z.) 1868, p. 415. Mr. C. R. MARKHAM, whilst pointing out, in the Journal of the Royal Geographical Society of London, the baneful consequences of this uprooting of forests in the southern parts of India, proceeds as follows:—" The cultivation of the quinine barks, however, replaces " in time what it has destroyed, inasmuch as it raises another forest in the place " of the one it has rooted up. Four years suffice for the Chinchonas to attain " a height of 20 feet, and, by means of their luxuriant foliage, to bestow the " requisite amount of shade."—C. H.

The greatest care must be taken not to allow any weeds to gain the upper hand amongst the young plants; but opinions vary considerably as to the best methods of weeding and turning up the surface of the soil, so that no positive decision can be hazarded. Any measure of that kind must be, in every respect, compatible with local circumstances, for less injury would arise from the existence of a certain quantity of weeds than from the inexperienced or negligent use of sharp-edged agricultural implements. It is needless to state that a different mode of treatment is required, respectively, for very young and more advanced plantations, and it may be remarked here that every species of weed is not to be set down as baneful. For example, some very useful weeds are produced by such *Compositæ* as the *Ageratum, Eupatorium, Erechtites,* and *Senecio* species. These last three, which, it is said, were introduced with some Brazilian coffee into Java in 1845, by Governor Rochussen, have already spread over the whole of that island and a portion of Sumatra.* They keep the soil more or less loose, and furnish an excellent green manure, so that they should not be extirpated, but rather be allowed to remain in rows in the plantations. The labour in the plantations also depends on the monsoons, so that great care must be taken not to injure the plants or to carry on the process of weeding and slackening of the soil in such a way as to lose the benefit of the best kind of earth.

It is a widely-spread opinion that the roots of the Chinchona and coffee trees should not be exposed. This is not the place to enter into any detailed examination of that question, but it may be remarked that if, with the view of avoiding any anticipated injury, the roots be too much covered with earth, or if the stem be too closely surrounded with soil, so as to be, as it were, buried therein, the remedy would be assuredly worse than the disease itself. Such an

* See Hasskarl, Proceedings of the Dutch Academy of Arts (1857), v. p. 100; also Flora (Bot. Zeit.), 1858, p. 250; also Bonplandia, (1859), vii. p. 177; Miquel, Flora Ind. Batav., ii. p. 97, a.—C. H.

elevation of earth around the stem can seldom be had recourse to with impunity, and the younger the stems are the more sensitive they become in respect of such an excess of attention. It is necessary also to be very cautious in the application of bands for the support of weak plants, for the slightest friction or compression of the stem or of the branches would result in injury to the bark.

Mode of Multiplying the Plants.

Before proceeding to the process of rearing the plants, it will be proper to ascertain for a certainty whether there be any opportunity, at the right time, of setting them in the open soil, and to that effect the preceding observations and instructions are to be kept in view.

The Chinchona trees are multiplied by means of seed, slips, layers, buds, &c. By making use of slips, a portion of the mother plant is endowed with an independent existence, and in that way the preservation of the species, together with all its peculiar marks of recognition, is guaranteed. Many plants degenerate when the re-planting is effected by means of seed, and so far is the increase by means of slips to be preferred; on the other hand, this mode of propagation necessitates much more practice and attention, and, if injury to the plantation is to be avoided, can only be carried out under proper and costly arrangements. It is not yet clearly ascertained whether the various trees in Java propagated from seed have thereby deteriorated. The *C. Pahudiana*, for example, is multiplied by seed, but it has not shown any decided falling off, either in respect of its external appearance or its quantity of alkaloid. Moreover, there are thousands of *C. Calisayæ* reared from Java and American seeds, and yet creating no apprehensions as to any degeneracy of the species; but it is, nevertheless, well worthy of remark that plants which have sprung from seed of the same tree not inconsiderably vary in the size, form, and hairy fibres of their leaves. The same differences, however, are discernible in leaves of one and the same tree, thus leading to the conclusion that the formation of the leaf is not *per se* a sufficient mark of

distinction, all the less so, indeed, that that formation depends on the changes in the tree itself and on active external influences.

With reference to the difficulty previously mentioned of defining the Chinchona trees in a botanical point of view, we feel bound to refer to the opinions of certain writers, whose authority in questions of science does not admit of any reasonable doubt. De Vriese, when endeavouring to prove the identity of the *C. Calisaya* which was reared by him from seed given by Hasskarl, incidentally observes :— " I also take into account the formation of the leaf, which, " in point of fact, is different from that of any other kind " of Chinchona; that leaf is oblong or of a lance-shaped " oval form, with obtuse points, narrower in the under part, " seldom coming to a sharp point at both ends, void of hair, " shiny, or—particularly on the back part—with very fine " slight down on the veins, and with peculiar cavities in " the axillæ of the veins." And further on :—" The leaves " are soft to the touch, as I have already said, without " any hair, except here and there a tortuous, long, stiff " sort of bristle, which for the most part falls away at a " later period," &c., &c. (De Vriese, " The Quinine Tree," p. 105.)

It is clear from this that De Vriese only had very young plants in view, for in the genuine and mature *C. Calisaya* there is nothing to be seen, except by way of exception, of all the hair he is here speaking of. Even the peculiarity of the so-called cavities in the axillæ of the veins of the leaves is by no means so distinguishing a characteristic, for it is met with in other species of Chinchonas, for example in the *C. Condaminea* and *C. micrantha*, as well as in other kinds, of which I am still uncertain, and which Miquel intends defining.

Mulder, Miquel, and many other authorities, have declared that " barks which abound in quinine originate " from such plants as are recognized by comparatively " small leaves, resembling leather, as well as from such " as are pressed down in the axillæ of the nerves, and " have leaves with no hair, or at least with none that is

" not of slight texture;" also "that the fruit of the tree " in question is short and oval, and crowned with a per- " manent calyx, the spermatic wings not being pierced," &c. &c. We have already expressed an opinion as to what degree of importance is to be attached to the cavities and the hirsute covering; in reality some of our *C. Calisayæ* do possess small leather-like leaves, but in others, on the contrary, the leaves are some 0·31 mètres in length, and some 0·17 mètres in width, and these latter cannot assuredly be described as small ones. Still larger is the leaf of the *C. succirubra,* in which, however, there are no cavities, and yet this species of Chinchona, from which, according to Klotzsch, the red quinine bark is obtainable, is particularly rich in alkaloids. On the other hand, the *C. micrantha*—a species containing but a small quantity of quinine—has a very large leaf, with clearly defined cavities, such as are above described.

It is certain that much yet remains to be done with regard to defining the various kinds of Chinchonas, but this is not to be wondered at, inasmuch as only dried portions have been hitherto subjected to examination, there being no perfect collection at hand. It will be, therefore, of the utmost importance to study, *in naturâ,* the trees now under cultivation here (Java), and there are grounds for hoping that an impartial investigation will shortly take place.

Duly constructed "multiplying houses" (glass houses) are required for the increase in question, whether resulting from seed or from slips, and if the planter cannot depend on having an equality of temperature he is liable to lose both his time and his stock. Whatever may be the form of those houses, a glass covering is indispensable, in order to admit of the free passage of light, but care must be taken to moderate its degree, and more particularly that of the sun heat. These houses must be kept perfectly closed, in order to retain an equality of temperature and moisture.

The Chinchona seeds are extremely fine and light, yet winged on all sides, and thereby very liable to be detached; but if sown in properly prepared soil and supplied with the

necessary moisture by regularly watering them, they will lose but few, or even none, of their germs. Any excess of moisture is, however, to be avoided, as it would only dislodge the sprouting seeds. The mode of proceeding is as follows:—Fill an ordinary earthen flower-pot three-fourths with sand, with a layer of loam well kneaded with water; place the seeds on this layer, after they have been steeped in water for some hours previously, and then set the pot in a pierced water-stand, so as to admit of the moisture being regularly sucked up by the seeds. Too much moisture rots them, and sudden changes of drought and wet also prove fatal. Let all this be well attended to, and allow a full current of light, but the rays of the sun should not fall on the seeds. Before making use of the sand and loam they must be slightly heated or manipulated with hot water, in order to destroy any organic life in them.

The seeds retain for a long time their germinating power if gathered when ripe, and if well exposed to the air and kept in a dry place. Under favourable circumstances fresh ones sprout forth within twelve days. After germination, the tender plants, which meantime have formed a couple of little leaves, are transferred separately to an earthen pot, or planted in a piece of bamboo cane. These young plants can be easily removed from the seed pots, as their roots do not pierce through the layer of loam; the operation in question being very skilfully effected by permanently engaged workmen, who, for that purpose, make use of small flat-cut and split bamboo sticks. Several plants will find sufficient room in one large pot, filled with duly selected garden soil, but they must be kept for some months in the glass houses, as when young they suffer much and are slow of development when exposed to the open air, even when protected against rain and the heat of the sun. Even in the glass houses, however, they should be supplied with sufficient light and moisture. Once they have become somewhat strong and attained a certain height, they can be, without any risk, transplanted to covered beds in the open air, and it is then no longer necessary to keep them separately in the pots. In these beds they can be planted,

like the coffee plants, at a distance of two to three décimètres one from the other. We must expect here, as with regard to other plants, a cessation of development, and in fact an apparent falling away; but under skilful treatment those in question will soon grow accustomed to their surroundings. In plantations on a large scale it would be impossible to devote a pot to each of the plants, or to retain them in closed glass houses until ready to be removed to the open ground.

Should the plants remain in the above houses and not be exposed to any sudden shifting, they will of course grow up quicker, but in general they attain, in nine or twelve months, a height of from two to three décimètres, and then they can be transferred to the plantations, where they will require no other protection than the previously-described gabion-like baskets. An attempt has been made to plant, between the rows of the young trees, Indian corn, and, for its protection, cassavas (yuca), so as to afford food for the labourers.* This will be of great benefit to the ground and the plantations themselves, and the work can be done by women and children. Although, however, this mode of inter-planting will afford some protection, the use of the baskets for covering purposes cannot be dispensed with, nor should we be in any way justified in doing away with "shade trees," which are of great service in open and exposed sites.

An attempt has also been made to transfer the seedlings immediately to the covered nursery beds, but this has retarded their growth, and in the absence, even though temporary, of the requisite care and attention, they soon manifest a great tendency to fade and perish. Still experience shows that that process is a practical one, when

---

* On the 4th of January 1855, consequently three weeks after my arrival in Java, I suggested this mode to the Resident of the Preanger Regency, and it was carried out, although on a comparatively small scale. It appears, too, that it led to some favourable results, but when the maize became ripe the monkey tribe could not be kept away from it, and the like observation applies to the wild swine, which attacked the cassava roots, so that the inter-planting referred to proved dangerous to the young Chinchonas themselves, and, under the then existing circumstances, had to be abandoned.—C. H.

there is question of cultivating the Chinchonas, as a matter of secondary consideration, and for the supply of one's own requirements, or for the sake of avoiding the expense of special establishments for rearing those trees. In that case, and more especially during the first few months, the nursery beds must be very carefully sheltered from the wind and the direct heat of the sun, and in general treated with great caution. If this be done, the cost of production will be recouped by the harvest obtained.

It is worthy of special remark that, according as the young plants are reared and transferred, they manifest striking differences; if they remain, for example, in the glass-houses their leaves assume a fine glossy appearance; on the other hand the influence of the external air with all its variations speedily converts it into a rough one. The like difference is perceptible even in older plants, in proportion as they are more or less sheltered. In the absence of any special site for the cultivation of the trees, the seeds should be sown in the planter's dwelling house.

The mode just described is employed in rearing the year and a half old *C. Pahudiana* plants, the roots of which contain one per cent. of alkaloid. In fact MAIER has prepared from that tree a comparatively large quantity of quinine. If the home planter in question can go one step further and have it in his power to transfer at once his sprouting plants to the open fields, he will have contributed to solve an important question, and 300 "bouw" of land would be sufficient to afford, in a short time, a regular supply of quinine for Dutch India.* We must not omit to state here that the quinine which, as already mentioned, Maier extracted was obtained from the roots of the least useful kind of Chinchona, and that there is more than a sufficient quantity of seed in Java to supply a far richer quality without any additional trouble or expense. With all this, however, the cultivation of young Chinchona roots should be only, like that of madder, a secondary occupa-

* One Dutch "bouw" = 500 Rhenish square rods; 7096·49 square mètres = 70·9649 acres (1 acre = 100 square mètres). Behm. Geogr. Handb., lxix.—C. H.

tion, whenever it can be carried on without a disproportionate cost, and should not be allowed to interfere with the regular rearing of quinine producing trees.* With regard to artificial means for increasing the plants they are well enough in theory, but likely enough to prove detrimental unless accompanied by practical experience, but whether the multiplication is sought to be obtained by slips, layers, or knops, the same principles must be adhered to; the knops must be forced to unfold themselves. Each slip should have at least two knops, one of which is to be covered by the soil wherein it is to take root. The slips should not be too old; young lateral sprouts, carefully broken off on the ground, are the readiest and most certain to take root, but it is advisable to procure them only from such mother plants as are still somewhat young as well as strong and healthy. The slips can be set separately in a small pot, or several together in a "multiplying pot," as in the case of seeds, the pots being previously filled with earth. It is of advantage to rest the surface of the slip on a small pot-sherd, which absobs the sap that exudes from it, as that sap might otherwise rot the slip, and, in fact, not unfrequently does so. The successful sprouting of the slips depends mainly on a suitable supply of moisture, and much experience is requisite to ascertain what would be the proper degree.

The hopes entertained here in Java with respect to planting slips in open beds have been disappointed, for closed up glass-houses cannot be dispensed with, so far as artificial propagation is concerned. Even after the slips

---

* *See* Hasskarl, Flora (Bot. Zeit.), 1862, p. 325. "In the event of the "chemical researches of Dr. de Vry establishing the truth of the assertion that "the roots of the *C. Pahudianæ* (How.) are so particularly rich in quinine, "that there are at the present moment hundreds of kilogrammes buried as it "were in the earth, there being such an exuberant number of that species of "Chinchona in Java, in that event (I repeat) the cultivation of the Chinchonas "must take quite another direction. The species in question must, in fact, "be reared, not for the purpose of producing high trees, but of keeping them "at a low elevation, furthering as much as possible the formation of the roots, "without any particular attention to the barks, the roots being looked to for "the production of the quinine."—C. H.

have taken root—and some require for that purpose three or four weeks, others, however, as many months—they must be carefully attended to before they are strong enough to be set in the open air. For that reason they should be kept for some time longer in covered beds, just as the seedlings are, until, in fact, they are sufficiently developed to denote the existence of the requisite vital power. It may be here remarked, that if the cutting of the slips be not confined to the youngest shoots the mother plant is much impeded in growth and greatly weakened. For that reason special plants, or so-called "stock plants," have been set aside for the above purpose in British India, and, by means of artificial warmth, are made to produce a greater number of strong young sprouts.* With remarkable speed, too, has the increase been effected in those parts by means of layers, which in reality are nothing else but slips that are allowed to remain in partial connection with the mother plant. The latter is "layed" so soon as it attains the height of one foot, and the compression which results from that operation wonderfully facilitates the formation of a large quantity of young sprouts along the entire plant, so that it becomes, as it were, a rich nursery of slips. The operation of laying, however, requires practice, and no planter should undertake it who has not been specially engaged in artificial reproduction. On the other hand, it will be easier for such persons to occupy themselves with slips, and practice in that respect will more speedily lead to perfection than any description can possibly do. One thing is certain, viz., that the quickest and surest results are obtained by sewing seeds, and it may be added that any planter hoping to increase his stock by artificial processes will be disappointed unless he devotes special study to the subject, and is willing to spare neither time nor money.

It is to be hoped that the writer will not be censured for devoting such little space to this portion of his book, as his

---

* This process is in opposition to the above rule that slips are only to be taken from strong and healthy plants, and that the latter are enfeebled by the removal of the former.—C. H.

main object here is to adduce some general rules, based on experience, in respect of a species of cultivation but little understood at present. In fact, he merely seeks to point out the way of carrying out certain recognized instructions and principles with which every practical agriculturist and planter must be already well acquainted.

Utility and Product of the Cultivation of the Chinchonas.

After having perused all the foregoing observations and statements one may naturally ask, What is the benefit resulting from the rearing of these trees? This question can only be answered presumptively until something positive can be adduced; but it is necessary, above all, to remind the reader that the primary inducement to the acclimatization of the Chinchona was not the prospect of pecuniary gain, but the interests of humanity at large. Mr. J. J. Rochussen, formerly Dutch Colonial Minister and Governor General of Dutch India, thus wrote in 1863 :— "It was not in a spirit of speculation—no, but as an act of "humanity—that the Government of the Netherlands "undertook and completed this work; one over which "they threw no veil of mystery, and in which they seek "no monopoly." (*Sur la Culture des Quinquinas à Java*, p. 27, ss.) Everyone, too, will readily agree with the remarks made by the Austrian *savant*, Dr. Pleischl: "*Sine Chinâ ejusque præparatis chemicis nec nollem nec "possem esse medicus*" (Without quinine and its medical preparations I could have neither the wish nor the ability to be a doctor),* a remark which completely justifies the exclamation of the above-mentioned M. Rochussen, viz.: "The eyes of Europe are fixed on this undertaking, one "exciting in the highest degree its interest, for the main "object is to secure to the sick what may be called their "bread, and to offer it to them at a price which shall not "exceed their means."

---

* *Ueber die Northwendigkeit, Fürsorge zu Treffen*, &c., p. 3.

Based as it is on such incontestable utility and on such good principles, and become as it has a necessity, the undertaking in question is one which, if accompanied by sound economy, may reasonably be expected in the long run to yield returns much in excess of the expenditure. The Chinchona is sought after and attended to for the sake of its bark, but we by no means assert on that account that other parts of the tree, for example, the leaves and the blossoms, are devoid of healing power. In fact not only have alkaloids been found in the leaves, but also quinovic acid; and for that reason the leaves have been recommended by De Vry to the notice of apothecaries. Phœbus ("Cologne Gazette," 30th May, 1865) expresses a wish to see the particularly sweet scented blossoms introduced into commerce, and ascribes to them a curative power.* In the bark of the root there is generally a larger quantity of alkaloid than in that of the trunk, whilst the wood itself is so beautiful and so hard that in time it will for a certainty come to be held in high estimation by cabinet makers.

Previously to the discovery of the alkaloids, only the barks were made use of, and that in the form of powders and decoctions, which as febrifuges and tonics are duly appreciated; but there are grounds for attributing considerable value to the substance called chinchonine, although less to quinine. Pleischl, Oppolzer, Seitz, Briquet, Bouchardat and others set down the medicinal power of the former at one half that of the latter. Manifold and important, too, are the various pharmaceutical preparations from Chinchona bark recently introduced into commerce, amongst which deserve particular mention the *Quinium* of Delondre (Delondre and Bouchardat, *Quinologie*, p. 43), and the wine or syrup of Laroche; the object of all these preparations being to offer, under easily taken and practical forms, the curative component parts even of the barks of inferior quality.

For the present, we may confine ourselves to the *harvest*

* In Peru the cascarilleros frequently make use of the blossoms as a sort of tea.—C. H.

of the Chinchona barks, one which is going on during the entire year in America, and which in the rainy season only is accompanied with any particular difficulty. Whether it be advisable to leave unnoticed the season of the year at which the barks are to be collected, cannot at present be exactly determined, and we shall still go on groping in the dark, in respect of that point, until the mystery be penetrated by means of continuous observations and analyses, only practicable in the course of a regular cultivation of the trees. In America, the gathering of the bark may be termed a regular chase or hunt, one undertaken almost at hap-hazard, although some governments may of late have monopolized the produce. The *cascarilleros*, or bark-gatherers, form a particular caste, and require both courage and perseverance in their pursuits. They unite in small bands, and under a chosen leader offer their services to private individuals or commercial firms.* Once on their journey, they have dangers innumerable and unheard of difficulties to encounter, for what they go in search of is to be found only in the remotest and most inhospitable mountain regions, the access to which is fatiguing in the extreme; a few primitive roads, or rather entangled footpaths, being the sole evidences of the struggle between man and these wildernesses of olden forests. Our readers will, therefore, readily understand that it is no easy matter to regulate the search in the Andes, particularly when the disturbed state of the republics in those quarters is taken into consideration; one thing is certain, the regular inspection of the cascarilleros, during their journeys, is to be regarded more as a desideratum than as an object of easy attainment.

For days, and even weeks, are the cascarilleros obliged to proceed the best way they can, up and down hill, amidst unceasing obstacles and perils, until they reach the object of their journey; and even then comes, not unfrequently, the

---

* The cascarilleros always require considerable pecuniary advances in respect of the bark to be delivered, and often enough they do not commence their journey until they have expended in aguardiente (brandy) the greater part of the money advanced for their subsistence.—C. H.

greatest difficulty of all, viz., to draw near the Chinchonas themselves, and to get possession of the bark. Generally they find it necessary to fell down some trees in the immediate vicinity, and also to effect a clearance, and no one can form an idea of the arduous nature of that operation who has not witnessed it in these primitive forests. It is unnecessary to add that, in the course of time, the search after, and collecting of bark becomes more and more difficult, and more and more costly; even the once richest districts are now penetrated almost in vain, and yield only a middling or even trifling quantity. [Compare, on the other hand, Miquel Flora, Bot. Zeit., 1868, p. 463, from Gids, 1868, p. 258:—"The "disquieting reports, spread by French travellers, respecting "the extirpation of the Chinchona forests in South America "are not only not confirmed, but the truth is that, on the "contrary, extensive and hitherto unknown forests have "been discovered in that quarter."] Everywhere, too, the best kinds of bark and the finest trees become the first victims, so that it is necessary to penetrate still further and further in order to obtain anything like a requital for the trouble taken. It would here lead us too far to refer to all the narratives in that respect and to observations of eye-witnesses, such as, amongst others, WEDDELL, DELONDRE, MARKHAM, KARSTEN, and WARSZEWICZ, who unite in describing not only the intrepid and persevering character of the cascarilleros, but also the reckless nature of their proceedings, whereby the future of the Chinchona cultivation is endangered. It is true that, after being felled, the trees possess the faculty of shooting out again, but the rude inconsiderate mode of the former operation itself, as well as the accidental or wilfull destruction of the sprouts, must necessarily very much lower our expectations as to the resuscitation of the Chinchonas *in that way*. Moreover, the great mobility of the seeds is prejudicial to the sprouting, so much so, indeed, that in these dark forests, and under such negative conditions, germination can only be regarded as an exception. According to Karsten, many seeds shoot up in the forests, thus hewn down by the cascarilleros, and bring forth young plants; but in Java, where for years

past, hundreds of Chinchonas could have cast their ripe seeds over the plantations, where, moreover, millions of seeds have been strewn in the forests, after clearances had been effected, no plants have sprung from this natural or artificial mode of sowing.

In their search after the Chinchonas, the most experienced cascarilleros—the so-called "Diestros" (the Expert)—lead in the van, and, instinctively as it were, detect the vicinity of those trees by a few leaves lying scattered on the ground, or borne hither and thither by the winds. The trees themselves, which stand apart from their compeers of the forest, are discovered by the peculiar glitter of their green leaves.* Once a proper site is fixed upon for beginning the work, they encamp, set about cultivating the ground, in order to procure food—such as maize and pulse—during their uncertain stay, and then the little band disperse in various directions, only a few remaining with their leader, in order to attend to head-quarters, and make all necessary arrangements. It is here that the collected barks are brought, dried and assorted, the smaller ones, gathered from branches and from the thinner kinds of trunks, being simply dried in the sun, whereby they acquire the rolled appearance of cinnamon, and the name of "canutos." With respect to the larger pieces, it is often found necessary to subject them to the action of fire, and, if the weather be favourable, they are piled like fire-wood one above the other, and are so much compressed, either by their own weight or by the superposed stones, there they soon become dry and assume a flatter form. In the event of felling a tree of unusually large size, the cascarilleros employ hard brushes to free the trunk and the thicker branches from any rugged appendages, and then mark the trunk by means of circular and equidistant cuts. The next process is to peel it with knives, the circular sections in question serving to secure, as much as possible, pieces of the like length. The barks of smaller trunks and of the branches are not, in the first instance,

* The cascarilleros, according to Weddell ("Histoire," &c., p. 9) climb up the tops of high trees, in order to take a survey.—C. H.

deprived of their moss covering, and are thereby easy to distinguish. All this being done, the barks are packed up in cases, barrels, or tin chests, or in buffalo skins with the hairy sides turned inwards.* These packages known by the name of serons, generally weigh from 70 to 80 kilogrammes, and not unfrequently contain various intermixed sorts of Chinchona barks, which have to be resorted by traders in Europe. Delondre and the Dutch Consul in La Paz, Bolivia (Mr. Schahkrafft), both state that, amongst the barks consigned to Europe, entire cargoes are composed of worthless substances, but this circumstance should not excite any immediate suspicions of fraud, as it happens frequently that the best kinds of bark contain no traces of alkaloids, and it has been already said that, in their regard, the difference in quantity depends mainly on the local circumstances of site, climate, and soil.

The yearly export of Chinchona bark from America, must be something very considerable.† More than once has the export been prohibited, for example in Bolivia, from 1852 to 1860, and from that country alone there were exported about 2½ millions of pounds between the year 1861 and 1863. In order to give an idea of the enormous consumption, it will suffice to state that the manufactory of Messrs. Pelletier, Delondre, and Levaillant, of Havre, purchased in one year (1867), by contract, 12,000 serons of King's Bark (*C. Calisaya*), each seron containing about 46 kilogrammes. Weddell states that a tree of powerful growth can yield some 6 or 7 arobas, of 11½ kilogrammes, of dry bark, and

---

* This description of the collection and desiccation of the bark is taken from Weddell's "History," &c., p. 11, and from the engraving in the title-page. With regard to the packing, Weddell says (p. 12), "I have to make a "few remarks with respect to the process of packing. The barks are conveyed "in packages of nearly the same size, sewn up in coarse canvass, brought for "the purpose. These packages are transported on men's backs, or by donkeys "or mules to the depôts in the villages, where they generally receive external "coverings of fresh hides, which are made very strong by drying. In this "form, they are known as serons, and so arrive in Europe. I have not yet "seen any packing in cases, &c."—C. H.

† If this be the case, a large quantity must be smuggled across the frontiers to Peru, and introduced, *viâ* Arequipa and Islay, as "cascarilla contrabandada" (contraband bark).—C. H.

that from one tree, 10 mètres in height, trunk 2 décimètres in diameter, about 9 or 10 kilos. were obtained. (Weddell, Hist., p. 37.)

This will be the place to draw some conclusions as to the probable amount of produce in Java. In November, 1866, ten *kilogrames* of bark were sent to Holland, obtained from a *C. Calisaya* which had begun to decay at the crown and which on that account had been felled a few months previously. It was from 12 to 13 years old, 8·125 mètres in height, the diameter of the trunk being 0·8 mètre, and the bark was about 1 centimètre in thickness. Some portions of it were subjected both in the Netherlands and in Java to chemical examinations, yielding 5·77 per cent. alkaloid for the most part genuine. Even the best kinds of barks have seldom been so productive, and those in question met with a very favourable reception on the part of the Amsterdam merchants. It was the same tree which was reared from a slip of the one that De Vriese exchanged in Paris in the year 1861. It was planted at Tijbodas at an elevation of 1,430 mètre, and on a soil which was not particularly fertile, and where it was exposed to the full light of the sun. Since the felling of the trunk, the root has put forth vigorous sprouts, such a result is more than satisfactory, and it is one which of course cannot be expected in regard of the Chinchonas which were subsequently, or which will be hereafter reared, in fact, it may be set down as a fortunate exception. Nevertheless, it is a conclusive proof of the adaptability of the soil and climate of Java to the cultivation of the above trees, and it may be added that there are several of the like size in the island.

In Table B. (annexed to this work) will be found some generally encouraging details respecting the growth of the Chinchonas, and basing our hopes on the opinions expressed by that experienced planter Dr. Anderson, the manager of the plantations in Bengal, we have every reason to be confident as to the future results of the cultivation in Java at the various heights it is essayed. In his official report Dr. Anderson says that these are the first Chinchonas trees which have blossomed in this part of India, and the very

fact of their having thrown out buds proves that the climate of Sikkim is adapted to the cultivation in question. Perhaps the conclusion to which he arrives here may be ascribed rather to fortuitous occurrences than to any rational consequence of general practical experience; for the blossoming may have been an unseasonable one, and therefore of no real value. At Lembang also at some 1,251 mètres above the level of the sea, the Chinchonas blossom very quickly, but one can easily see that that speed will lead to nothing. Van Warszewicz ascertained in America, and the fact was further confirmed by him here, that as a rule such branches as have blossomed subsequently decay; and it may be taken for granted that any imperfectly developed tree can only be injured by budding out too prematurely. Another remark of Warszewicz to the effect that no flowers are ever found at the summits of the trees but only on the side boughs, is not in accordance with the experience acquired here in Java, where in young plantations we find at times a flowery development at the extremities of the principal axes of some of the trees; but those plants although very pretty to look at, under such circumstances awaken no hopes for the future. At Nagrak which, like Lembang, is situate on the Tangkuban Prahu, but 374 mètres higher up, the trees do not put forth buds so soon, but their external appearance is healthier and fresher, and if those trees do not attain so speedily to their full growth, this apparent loss of time is amply compensated by a more abundant and probably a more valuable crop of bark.

And here we must confute the erroneous impression that the Chinchonas are not fit to be turned to account before they are 30 to 40 years old, and even then only at the sacrifice of their existence. It is true that the age at which the maximum formation of alkaloid takes place is not yet determined, nor even whether there be progress in that respect up to certain limits and then retrocession; but it is certain on the other hand that there are trees under 13 years of age (*see* Table C.) containing a not inconsiderable quantity of alkaloids, and that under favouring circumstance they may be made to produce abundance of

bark. By setting down therefore at eight to ten years the period at which trees become serviceable we shall be within the mark, and as regards their total extinction after being once felled, the real fact is that with ordinary care the sprouts become useful a few years later with the prospect of yielding a fresh supply of bark.

Mr. McIvor, the skilful conductor of the Chinchona plantations in Madras, is of opinion that a constant crop of bark is to be obtained by only *partially* peeling the trees, and he has already invented a particular knife, "McIvor's "patent barking knife," for that purpose. The process, an easy one, consists in cutting off strips of bark along the entire trunk, and then after a short time the parts thus laid bare put forth new bark, that process being facilitated by applying a covering of moss. It is true that there is a reproduction of the bark in that way, but only a very slow one, and should there be any attempt to procure that article by a partial stripping as above described, and should that delicate operation be entrusted to native labourers, then assuredly all the trees would be injured although involuntarily, and great losses could not fail to ensue. If we may judge, however, by later accounts the idea appears to be abandoned, and in fact it would seem to be as impracticable a one as that of cutting off every year only some of the branches in order to make use of the bark, as is done with respect to cinnamon.

The expedient of covering the Chinchonas with moss is regarded as a powerful auxiliary for the better development of the bark, and for increasing the quantity of alkaloid. It is employed on a large scale in Madras, and it has led to surprising results. It may be remarked, however, that in that part of India the planters are more fortunately circumstanced, and have greater resources at command, resources which may also be described as indispensable; but as regards Java we must await the results of the chemical analyses in the Netherlands before deciding whether the experiments that have also been made in the above island in respect of moss covering should be continued, and if so whether to a greater extent. The immediate influence of

that covering would be twofold as it would keep moist the bark of the trunk, and at the same time screen it from the rays of the sun. Nothing certain, however, is known as to the general effects of this auxiliary, and it may be remarked that whilst some quinologists hold that moisture and shade are requisite for the formation of alkaloids, others give the preference to dryness and light.

It will be only in some five or six years hence that the question need be raised in Java as to the best mode of profiting by the Chinchona plantations; and it is highly probable that the experience obtained in British India will serve as a guide in that respect. With regard to the nature and mode of cultivation, it may be assumed that the Chinchona plantations should be treated in exactly the same manner as the field timber in Europe, and be carefully cut down at certain periods. There will be also time enough to treat of the best mode of peeling, drying, and packing; for once we are in a proper position to turn the Chinchonas to profitable account here in Java, we shall again fall back on the example set in British India, certain of the co-operation and advice of competent authorities. Meantime, we can make a few experiments of our own.

There can be no doubt but that the most convenient and advantageous mode of packing the bark is in skins, of which there is assuredly no want here, and, taking into consideration the number of wild bamboo bushes so frequently met with in the vicinity of the Chinchona establishments, it will be readily seen that baskets or bales could be very easily formed from that ready material. With reference to exports, it may be assumed that the finest and richest kinds of barks will be selected, whilst the inferior sorts, the chips, &c., will be more advantageously worked up on the spot; in order to procure either the required quantity of quinine-salts and preparations, or merely raw alkoloid, the latter being forwarded to Europe for the purpose of being clarified. In this way, the heavy cost of transporting a mass of useless cellular substances will be economized, and it is well known that the process of manufacturing the beautiful crystallized

sulphate of quinine, so much sought after by the trade in Europe, is a secret with which no one is acquainted, save Messrs. Jobst and Zimmer, of Frankfort-on-the-Maine.

Concluding Remarks.

The object of the foregoing pages, was to collect in a summary form, all the instructions hitherto derived from experience, with respect to the regular cultivation of the Chinchonas in Java, as well as whatever information was to be obtained in the multifarious and widely scattered books on the subject. It is to be hoped that the compressed nature and brevity of this production have not conduced to obscurity. When, in the course of a few years, the cultivation of these trees shall have become a successful undertaking, both in respect of commerce and of the medical art, our knowledge of the subject will be enriched by more thorough researches, and many a point, hitherto obscure, will be fully elucidated. The, so to say, last word on this topic is not yet spoken, and it would be, indeed, permature, not to say rash, to venture on any calculations or any predictions with regard to the future. On the other hand, no one should be discouraged on finding that after 12 years successive labour, the results have not proved more favourable than they are. Rather let us derive courage from the certainty that we are at last on the right path, and indulge in the well-founded hope that the persevering efforts of various succeeding governments, efforts which have aroused a sympathetic feeling in the educated world in general, and amongst scientific men in particular, will end in a glorious success. No one has recently visited the Java plantations, without bringing away with him the impression that the Chinchona is flourishing there, and that it will soon (so to say), acquire the rights of naturalization. If we glance for a moment over the history of the acclimatization of various products which now enrich that colony, we cannot fail to regard in a favourable light, the cultivation of which we are now treating.

In the year 1690, the coffee-tree for example, was introduced into Java, and some 22 years afterwards, 894 pounds

of coffee were forwarded to the Dutch market,—much to the satisfaction of the directors of the company. At present, there are, on an average, as many thousands of pikkols* obtained from those trees, and the fortunate planter of a "coffee garden" now knows that, in four years time, he will be able to commence gathering in his crops. And yet, in 1725, consequently 35 years after the planting of the trees in question, appearances were so unfavourable that the Company's directors declared that "the numerous experiments which had been made, only "tended to prove that the '*Kawa*' (coffee), could not be "grown in this hot country." In the year 1836, a like opinion was expressed as to the tea plant, so that the far-sighted Provincial Governor, Mr. J. C. Baud, was obliged to dilate on the circumstances attending the cultivation of the first coffee-trees before he could raise the depressed spirits of the tea-growers; and now his persevering efforts are universally admitted to have been both rational and successful. Much time, as well as money, was also expended in the cultivation of cotton, silk, cochineal, vanille, &c., but, in the end, was verified the beautiful saying of Humboldt:—"Man, the restless, the ever-active—whilst "traversing the various parts of the world has forced a "certain number of plants to accustom themselves to all "climates and all heights; but this sway of his over organic "matter has not altered their nature. He has changed at "will the surface of the globe, and gathered around him the "plants of the remotest countries." On impartial consideration no one need be surprised at finding that any new undertaking is involved in obscurity, and that repeated attempts must be made, and no few disappointments incurred, before attaining the goal where perseverance is rewarded, and where former distrust and failure are put to the blush. The funds disposable for the cultivation of the Chinchonas are limited, and the work is carried on somewhat sparingly, but since 1865 it progresses regularly without any forced appliances.

* 1 Pikkol = 123·052, Zollverein pounds. (Hubner.)

Literature of the Chinchona.

Amongst the travellers who have devoted special attention to the Chinchonas in South America, and acquired reputation as writers on that subject, the following deserve special mention:—C. L. Condamine, 1737–8; J. de Jussieu, 1739; Santestevan, 1755; Mutis, 1760–1800; Renquifo, 1772; Ruiz, 1790; Caldas and Zea, 1800; Pavon, 1801; Tafalla, 1802–8; Humboldt and Bonpland, 1807; H. von Bergen, 1822; E. Pöppig, 1827–32; Weddell, 1843–8; Delondre, 1846–8; Hasskarl, 1853–4; Markham and Spruce, 1859–60; V. Warszewicz, &c.

During late years the following works have been published:

Rhode. Monographia Chinchonæ. 1804.

Graf. Die Fieberrinden. 1824.

V. Bergen. Versuch einer Monogr. der Fieberrinden. 1826.

Weddell. Hist. Nat. des Quinquinas. 1849.

Delondre, & Bouchardat. Quinologie. 1854.

Karsten. Die Medicinisch Chinarinden Neu-Granadas. 1858.

Klotzsch. Abstammung der rothen Chinarinde. 1858.

Markham. Travels in Peru and India. 1862.

Howard. Illustrations of the Nueva Quinol. of Pavon. 1862.

G. Planchon. Des Quinquinas. 1864.

Berg. Die Chinarinden. 1865.

A. E. Vogel. Die Chinarinden des Wiener Grosshandels, etc. 1867.

Soubeiran & Delondre. Introduction et Acclimatisation des Chinchonas. 1808.

Moreover, there are numerous scattered treatises by Reichel, Reichhardt, V. Martius, Pleischel, Phœbus, V. Warszewicz, Hasskarl, Spruce, McIvor, De Vriese, Miquel, Vrydag-Zynen, Junghuhn, Teysmann, Oudemans, De Vry, Van der Burg, Binz, G. Kerner, &c.*

* If it were our intention to give here a perfect bibliography respecting this subject we certainly should be open to the charge of excessive brevity. As that, however, was not our object, the reader will be pleased to excuse the omission of many writers whose works have served as guides for their successors.

It will be seen that books are not wanting, but let it not be imagined that our knowledge is therefore complete. In fact the contradictions are so numerous that we cannot say the subject is exhausted; assuredly not, when we find such distinguished men adhering respectively to two directly opposed systems of cultivation, and skilfully basing their arguments on the natural histories of the Chinchona emanating from divergent authorities. It may be observed here that statements which are not founded on generally admitted appearances are frequently prejudicial, inasmuch as they repose on isolated facts, and thus lead to a one-sided view of the question. All must admit that the majority of the quinologists have somewhat too hastily adduced their theories, although but few of them had the privilege of examining the Chinchona in its entire natural development and in its manifold varieties. What one writer upholds another rejects, so that the investigator runs the risk of being misled, unless he have recourse to personal experiences or to recognized authorities.

Not a little confusion still exists as to the botanical definition of the various kinds of trees and the mode of recognizing and classifying the barks, so that there is as yet a wide field open for study. On the other hand, the progressive cultivation in British India and in the island of Java is already elucidating the subject, and tending to impart useful knowledge. The sooner the principal, and as it were historical features, of all the various kinds are known the easier it will be to point out their proper position in the vegetable kingdom, to range them according to their origin, and thereby subject them to the principles of rational classification. It must never be forgotten, however, that the same genus of tree is, with respect to its bark, variously acted upon by the influences brought to bear on it; for the barks differ considerably, both externally and internally, according to surrounding circumstances. This fact will tend to establish more and more solidly the conviction that it is only by chemical analysis that the real therapeutic value of a bark can be determined. Once that conviction obtains, I hope to be enabled to append to this treatise a botanico-

pharmacological one on the Chinchona barks and products acclimatized in this island.

For the present this little work may suffice to awaken and increase a general interest in the important subject under consideration, and to prove that the Chinchona barks may not only become indigenous in the Dutch Indies, but also, so far as the higher mountain ranges are concerned, advantageous and salutary objects of national cultivation.

Supplement.

Reference has been made in the preceding pages to the bark of a thirteen-year old *C. Calisaya*, and we may state here that, at the request of the Dutch Government, it was submitted to the chemical analyses of Messrs. Mastenbroek and Gallenkamp, of Amsterdam, and of Mr. De Vry, of the Hague. It underwent the like process in the world-renowned quinine manufactory of Dr. Zimmer, in Frankfort-on-the-Maine,—these respective analyses agreeing in the main. The contents were found to be as follow:—

	0·952 per cent.	quinine.
	2·281 „	chinchonine, quinidine, &c.
Total -	3·283 „	alkaloid.

Let us now compare the results of two experiments on barks of the *C. succirubra* which were sent from British India and put up at public auction in London, viz.:—

——	No. 1.	No. 2.
Quinine - - -	0·638 per cent.	0·691 per cent.
Chinchonine, quinidine, &c. -	2·128 „	2·393 „
Non-crystallisable alkaloid -	0·212 „	0·268 „
Total of alkaloids -	2·978 per cent.	3·352 per cent.

These results would show the superiority of the Java barks, and De Vry states, in his official report, that he found full 5 per cent. of alkaloids, but principally quinidine. This result, however, must not be considered as an absolutely favourable one. It even appears by his private communications that he obtained nearly 6 per cent., at least more than

5·7 per cent., and that he was enabled to institute a comparison with the English barks, having received three samples of the latter, two of which he analysed as follows:—

No. 1.	No. 2.
6·8 per cent.	4·1 per cent. alkaloids, whereof
2·85 „	1·4 per cent. quinine, whilst the remainder consisted of chinchonine and chinchonidine.

Mr. De Vry might therefore have come to the conclusion that the Java bark was inferior. It would have been more advisable, however, to refrain from instituting any comparisons, for the Java barks were taken from a sickly thirteen-year old tree, and the English from not less than 600 sound trees from four to five years old. Moreover, with the view of obtaining equal results from the analysis of the bark of one and the same tree, it would have been necessary to reduce to powder the entire material in question, then carefully mix it together, and set aside a certain quantity for the purpose of being analysed. The very divergent nature of the results of the analyses of Java barks, by De Vry and others, justify the supposition that the Chinchona bark is not equally rich in alkaloids throughout the entire surface of the tree. Moreover, as already stated, the Java tree was in a weak condition, the top part in fact showing signs of decay, and the bark assuming a dark colour. It is however surprising that in this enfeebled and consequently abnormal substance De Vry discovered more alkaloid than in the sound bark analysed by Junghuhn (5·137 per cent.), and by Scharlée and Moens (5·717 per cent.). The last-named three gentlemen did not state the quantity of pure quinine, but contented themselves with including it in the analogous substances. It is, therefore, difficult to determine whether there was any loss of quinine in the formation of quinidine, &c. With regard to the latter, we shall treat of it a little further on, but meanwhile take notice of some facts borrowed from the private communications of De Vry, with reference to 11 analyses of Java bark (*see* the explanations to Table C.).

In general these results have not produced a favourable

54957

impression, but they are all the more worthy of attention that they again prove to us how limited is our knowledge of the subject in question, and what little right we have at present to pronounce any decided opinion. Perhaps it may be reserved for future generations of quinologists to move, so to write, in less subtle air or in less thick clouds. In the bark of one of our oldest *C. Pahudiana*, De Vry found only 0·11 per cent. alkaloid, and no quinine whatever, whereas some years later Junghuhn obtained from some pieces of bark of the same tree 1·052 per cent. of alkaloid, including 0·352 per cent. of quinine and analogous substances; Scharlée and Moens also discovering therein 0·521 per cent. alkaloid, and 0·946 per cent. quinine, &c. All these samples of barks were taken from a live healthy tree, covered with blossoms and fruit. What becomes now of the idea that the quantity of alkaloid increases with the age of the trees? The hope raised in that respect would also appear to be disappointed by De Vry's analyses of the barks of two four-year old *C. Pahudiana*, which grew near the older tree just mentioned, on the same soil and under like conditions. Precisely because these two young trees were of the same origin and age, one of them was covered with moss, as an experiment, according to McIvor's method, before yielding any material for analysis. From the bark of the moss-covered tree De Vry procured 0·07 per cent. alkaloid, with *an evident quinine reaction*, and from that of the non-covered trunk 1·675 per cent. alkaloid *without* any quinine reaction. This would appear decisive against the expedient of moss covering, but it may be urged that the species of moss to be employed is not altogether a matter of indifference. If, however, the active power proper depends on the kind of moss made use of, then it must be a cataleptic one, or, at least, my opinion is no longer tenable, viz., that the moss covering is beneficial to the bark of the trunk because it shelters it from the light of the sun and from moisture.

In two ten year old *C. Calisayæ*, which had been reared in the same place from slips, and which after an excessive production of fruit, died off, Mr. de Vry found in one 1·716

per cent. alkaloid, with much chinidine but scarcely any trace of quinine, and in the other 1·714 per cent. alkaloid, including chinidine and chinchonine, but no quinine (?). In the year 1865, Maier and Moens obtained from a tree of the same stock and plantation, 3·676 per cent. alkaloid, with 3·436 per cent. quinine and analogous matter. This tree likewise decayed after being long unsound. From a similar bark of the same age, Mülder obtained 3·700 per cent., and 2·100 per cent. alkaloid, amongst which were respectively, 2 per cent. and 1·4 per cent. quinine and the like.

It appears necessary to direct particular attention to these facts, inasmuch as it is precisely from these trees, which have given rise to such divergent opinions on the part of chemical analysers, that many thousand plants have been derived, either by artificial means or by sowing seeds. It would not be easy to account for the unfavourable results of De Vry's analyses, by merely referring to the unhealthy condition of the trees, particularly as the same chemist shows that the bark of the equally abnormal 13 year old tree contained a larger quantity of alkaloid. On the other hand, it is encouraging to find—and the fact is worthy of all attention—that in some two year old seedlings and slip plants, which were procured in the year 1865 from the above-mentioned 13 year old tree, De Vry discovered respectively, 1·31 per cent., for the most part quinine, and 0·146 per cent. alkaloid, with a manifest quinine reaction. The increase, by means of seeds, yielded therefore, a much more serviceable product, and that by slips a far inferior one, but these young plants were also in a feeble condition at the time they were felled and peeled. The unhealthy state of a plant cannot therefore serve as a criterion. In barks of the *C. lancifolia* De Vry found 2·06 per cent. alkaloid, chiefly chinchinidine; in the *C. succirubra*, 0·55 per cent. with a feeble quinine reaction; in a 10 year old *C. lanceolata* (identical with the C. Pahudiana ?) 0·28 per cent., principally quinine; and finally, in a 3 year old *C. lanceolata* 0·05 per cent., without any trace of a quinine reaction.

So far the results of chemical researches. Those results

appear as uncertain and divergent as the quina species themselves, with all their varieties. How then, can any one venture to deduce conclusions and build up theories therefrom and thereon?* Where no material is found existing, no question, assuredly, can be raised as to its value, so the great point would be to continue rearing robust trees in large quantities, and then at the proper time the produce will be duly estimated in the bulk, by commercial men. Opinions pronounced in respect of considerable quantities will throw more and better light on the subject than any detailed analyses of fractional parts, particularly as chemists do not seem to be as yet agreed as to the most approved method of separating the various alkaloids one from the other. (See Dr. Van der Burg's Pamphlet, Rotterdam, 1867.)

We may be allowed here to devote a few lines to the consideration of alkaloids in general, and of the chinidine in particular. In his report of the year 1862, Mülder asserts, whilst quoting the authority of other *savants* that chinidine, as such, is not found at all, but that it is a transformed product, originating during the course of preparation. Pasteur is of opinion that the light of the sun acts disintegratingly on quinine. Generally speaking, chinidine is considered to be isometric with quinine, of which it would be a hydrate. As for its therapeutical value, that cannot be called in question. Maier prepared quinine and chinidine from the young roots of the *C. Pahudiana*, regarding both preparations as perfectly adapted for medical use: and the experiments made with those two substances, with the consent of the Government, in the large hospital at Weltevreden, appear to bear out his views in that respect. In the important work of Soubeiran and Delondre (see page 46),† it

* In roots of the *C. Pahudiana*, Maier found, in 1865, more than 1 per cent. of alkaloid, for the most part quinidine, two years later he obtained from the same kind of bark 0·601 per cent. alkaloid, the relation between quinine and quinidine being this time, however, a more favourable one. These last barks were for a long time exposed to the influence of the external air.

† In the above work the passage here quoted, and which should have been met with in about page 138, is not to be found, but the data here given partly occur in Delondre and Bouchardat's *Quinologie* p. 43.—C. H.

is stated that "these alkaloids, quinine, chinchonine, quinidine, and chinchonidine, do not possess the like effective power. Quinine is the most active of the above four alkaloids, and the one which, despite the warm protestations of all the doctors who have made comparative essays of it, is generally employed in the healing art. On the other hand, Dr. Hudellet, of Bourg-en-Bresse (Department of the Ain, Burgundy), has declared that he did not know of a single case, either in the hospital or in the course of his private practice at Dombes,* where the marsh fever is endemic, in which the sulphate of the chinchonine did not prove really effective; and the like statement is made by Dr. Beauregard, of the canton of Eure, near Havre. A similar opinion is also held by Dr. Wahu, the head of the Military and Civil Hospital at Cherchell (Algiers), and by Dr. Briquet, whose authority is so great on all matters appertaining to the physiology and therapeutics of febrifugal alkaloids. The depreciation of the alkaloids, with the exception of quinine, is certainly much to be deplored, and acting from that point of view the English Government has recently appointed a medical commission for the purpose of subjecting them to a comparative series of experiments and of drawing up a report. The preliminary reports of this Commission, which have been so kindly communicated to us by the above Government, do not admit of the prejudices which militate against the use of the alkaloids and in favour of the sole employment of quinine. On the other hand, it would not be prudent to replace, in dangerous cases, so active a medicine as quinine by a less effective alkaloid of the *Chinchonæ*, or by such other products of those barks as have now become almost out of date and out of use. Professor Soubeiran, sen., shares our opinion in that respect, and expresses it in his lectures in the Medical Faculty. Moreover, there are certain kinds of fever which withstand the effects of the *sulphate*

* Formerly a small principality situate along the Lower Saone, with Trevcaux for its capital. It now forms a portion of the Department of the Ain. —C. H. e

" *of quinine*, but yield to those of the quina barks,—whe-
" ther it be that the combined operation of the tonic and
" aromatic principle may have become a necessity, or per-
" haps because—as I have some grounds for believing is
" the case—the two alkaloids, quinine and chinchonine, can
" jointly effect what it would be impossible for either of
" them severally to do."

It cannot be supposed that the quinine combinations, which have so generally obtained, are to be all at once set aside and replaced by others, neither would that be necessary or desirable. Once, however, the therapeutic efficacy of the other alkaloids is certified by the faculty, there can be no longer any objection to introduce their use into the various medical establishments, and once their credit is restored here in Java, they will soon acquire the confidence of foreign countries. Even if they be less powerful, this deficiency can be made up by larger doses, and still there will be an economy of expense. Taking, however, the worst view of the case, and supposing that in Java only such barks are produced as contain, for the most part, quinidine, chinchonine, &c., a supposition involving a very great improbability, even then, there would be no ground for apprehension, if the barks in question only continued to yield as considerable a quantity of alkaloid substance as the repeated analyses show they have hitherto done.

Dr. Scheffer, the Director of the Botanical Garden at Buintenzorg, Java, has lately had the opportunity of seeing and examining, *in naturâ*, the doubtful kinds of Chinchonas mentioned in Table C., and although he leaves the task of properly defining them to Professor Miquel, who has received some dried samples thereof, with an exact diagnosis, he nevertheless considers he is justified, even at present, in stating that those trees are erroneously taken to be *C. Calisayæ*, and that neither in Weddell's nor in Howard's works is to be found any description exactly applying to them.

Moreover, Dr. Scheffer compared the *C. succirubra* plants (introduced by Hasskarl) with Howard's description of that tree, which yields the red bark, and, to our satisfaction, found that they tallied, although, there are important differences between Hasskarl's *C. succirubra*, and those trees which were received in Java from British India. Several plants from these latter trees have shot up to a height of 4 to 7 mètres, but not yet blossomed, so that it is still impossible to institute a comparison between them and the *C. succirubra*, above referred to. The analyses, few in number, of the barks of the two varieties have proved in favour of the English one, and as the latter appears a more vigorous plant, every care will be taken to multiply the species.

The disadvantages of our old system of cultivation have been already described in detail, a system which required a disproportionably large tract of ground so that, on financial grounds alone, it was impossible to bestow on it the necessary care and attention. These technical or purely administrative difficulties are gradually becoming greater, in consequence of the destruction of the trees by wild beasts, particularly the rhinoceros (*Rhinoceros sundaicus*), the wild cow (*Bos sundaicus*, *Bos "banteng"*), and kidang (*Cervus "muntjac"*). Much injury, too, is done by falling trees, &c., so that the best and most vigorous trees are disappearing by degrees, after having long overcome physical difficulties, viz., want of light and excess of moisture. On a recent survey of the melancholy vestiges of the costly and arduous work of nine years, it was again found that whatever benefit remained could only be set down as an accidental one. It may be added that, at the same time, it was ascertained that no *thick* Chinchona barks are produced amidst the deep shades of the primitive forests. From some of the trees which had been thrown down by rhinoceroses and wild kine, the bark was peeled off and then weighed. Three seven-year old *C. succirubræ* yielded altogether only 2·910 kilogrammes of trunk bark; an eight-year old *C.*

Calisaya 2·45 kilos., and a *C. Pahudiana*, of the like age, 1·75 kilos. The small quantity of bark in the branches was not weighed. On the other hand the roots were well developed and covered with tolerably thick bark; but other trees of like size would, if they had grown in the light of the sun, have given twice the quantity of bark here mentioned.

With regard to the best mode of drying and packing the barks in Java, there will be time enough for parties engaged in the trade to come to a decision on those points, before any regular use can be made of the Chinchona plantations in that island. Experiments may be made, in these respects in some of the plantations that date from the year 1865, and which in 1871 will no doubt afford a supply of some thousands of kilogrammes. As the application of moss-coverings to the trees appears to produce effect in the course of a few months, they can be made use of, in due time, previously to gathering in the crops.

Bandong, Java (Preanger Regency),
July 1, 1868.

TABLE A.—CONDITION of the CHINCHONA CULTIVATION in JAVA, on the 30th of June 1868.

Chinchona.	Number of Plants.		Total of each Kind.		Remarks.
	In the regular Plantations.	In the nursery Beds.	June 30, 1868.	March 31, 1869.*	
Calisaya -	330,809	178,773	509,582	840,653	At the end of March 1864 there were altogether 14,625 live plants of all these various kinds, of which 7,584 stood in open ground.† The number of the *Pahudianæ* cannot be exactly stated. There were more than 900,000 plants in the primitive forests, but the greater part are sickly, or have already died away, in consequence of unfavourable local circumstances. Many were sacrificed when the soil, on account of its favourable position, was turned up again with the view of planting better kinds on it. The extent of the land devoted to these scattered plantations may be set down at 70 square "*Pfahl*,"‡ too great an extent to admit of proper attention; for the rhinoceroses and the wild cows had full play, and the havoc was both continuous and wide-spread. Such was the sorrowful spectacle offered on the occasion of each of the monthly surveys, and it was even found that the thick hedges which were placed around the finest trees proved of no avail. In the course of the year 1868, more than 600,000 plants will be springing up, and the ground is already in an advanced state for the reception of 300,000 more in 1869.
Succirubra -	5,003	22,575	27,578	39,512	
Condaminea	18,068	10,806	28,874	59,149	
Lancifolia -	574	—	574	812	
Micrantha -	343	43	386	409	
Pahudiana -	?	—	?	?	
Total -	354,797	212,197	566,994	940,535	

* For the sake of comparison I have given here the most recent results, showing that the number of Chinchonas *has almost doubled* during the nine months in question.—C. H.

† The products of the plantations, scattered through the forests by Junghuhn, before the year 1864, must be considered as a haphazard profit. Neither can we expect much from the plantations of 1864 and 1865 (altogether more than 21,000 plants), as they were planted on soil which was not thoroughly disforested, and were for the most part slips from unsound trees.—C. H.

‡ 1 square *Pfahl* (*Paal*) = 2·270878 *kilomètres* (Behn. Geog. Jahrb., 1, xix.)

TABLE B.—PROGRESS of the GROWTH of the CHINCHONA PLANTS reared in the PLANTATIONS according to the most recent Principles (height given in mêtres).

Chinchona.	No.	Name of Plantation.	Date of Planting.		Height on December 31st.		Circumference of Trunk on December 11th.		Height in the Year 1868.		Circumference of Trunk in the Year 1868.		Explanations.
			Month.	Year.	1866.	1867.	1866.	1867.	April 1st.	July 2nd.	April 1st.	July 1st.	
Calisaya	1	Tjiniruan	May	1865	1·530	2·400	0·090	0·130	2·730	2·950	0·145	0·160	The three *Calisayæ* trees No. 6, 7, 8, and 9, and the three *lancifoliæ* are growing in plantations in which there are some forest trees still standing. The above-named *Calisayæ* and *lancifoliæ* as well as the *succirubra*, originate from slips, and the other *Calisayæ* from Java seeds. The Nagrak *C. succirubra* plants were taken from more robust trees than those of Tjinuran. The difference in development is remarkable. About 20,000 plants which were raised from American *C. Calisaya* seeds, and which, towards the end of 1866, were set in the open soil, have prospered. Many of them are already two mètres high. Those which grow at an elevation of 6,000 feet above the level of the sea, do not spring up so quickly, but this implied delay cannot be safely ascribed merely to the difference of elevation. On the other hand, *C. Condaminea* is of quicker and more robust growth on these more elevated sites.
	2		„	„	1·240	2·100	0·080	0·130	2·200	2·400	0·140	0·150	
	3		„	„	1·110	2·200	0·060	0·125	2·400	2·600	0·140	0·150	
	4		„	„	1·730	3·050	0·065	0·090	3·270	3·600	0·100	0·100	
	5		„	„	2·000	2·900	0·100	0·195	3·000	?	0·210	?	
	6		„	1864	2·400	3·100	0·070	0·095	3·200	3·300	0·100	0·110	
	7		„	„	2·450	3·050	0·075	0·100	3·105	3·200	0·105	0·110	
	8		„	„	2·050	2·900	0·085	0·110	3·000	3·150	0·115	0·117	
	9		„	„	2·250	3·000	0·750	0·100	3·100	3·200	0·150	0·160	
	10	Nagrak	Feb.	1865	2·440	3·270	0·150	0·270	3·350	4·460	0·300	0·330	
	11		„	„	2·020	2·960	0·150	0·247	3·000	3·140	0·275	0·290	
	12		„	„	2·000	2·530	0·170	0·265	2·700	2·950	0·290	0·310	
Succirubra	1	Tjiniruan	May	„	1·280	2·300	0·065	0·120	2·500	3·000	0·140	0·155	In general, there are manifest differences in the same plantations and in respect of trees of the like origin and age. It often happens, too, that a plant will appear feeble month after month, and then, all at once, become vigorous, but the like occurs with respect to plants that have been long ago introduced, for example, the coffee plant, &c. The sites on which the plants most prosper are Nagrak and Riungunurg, at an elevation of 5,000 feet.
	2		„	„	0·890	1·500	0·045	0·070	1·800	2·200	0·080	0·090	
	3		„	„	1·800	3·850	0·110	0·195	3·950	4·050	0·220	0·240	
	4	Nagrak	Feb.	1865	2·320	4·000	0·170	0·310	4·106	4·480	0·340	0·360	
	5		„	„	2·170	3·830	0·060	0·280	4·210	4·600	0·315	0·340	
Lancifolia	1	Tjiniruan	May	1864	1·740	2·650	0·060	0·095	2·755	2·850	0·106	0·110	
	2		„	„	1·800	2·800	0·060	0·090	2·950	3·000	0·100	0·105	
	3		„	„	1·900	2·700	0·060	0·080	2·805	2·900	0·095	0·100	
Condamina	1	Riungunung.	Nov.	1866	—	1·820	—	0·060	2·120	2·480	0·080	0·100	

TABLE C.—RESULTS of the CHEMICAL ANALYSES of various kinds of CHINCHONA BARKS.

Analyses made by Chemists both in Java and the Netherlands.

Chinchona.	No.	Amount of Alkaloid.	Quinine and analogous Substances.	Chinchonine and analogous Substances.	Age (in Years).	Site. Elevation above the Sea.	Growing in Shade or not.	Examined by.	Remarks.
						Feet.			
Pahudiana.	1	0·4	—	—	4	4,600	in.	De Vry.	Sickly or decayed trees were principally made use of for these analyses, so that less favourable results were obtained.
	2	0·27	—	—	—	—	—		
	3	0·165	—	—	7	4,700	in.		
	4	0·700	0·700	—	7	4,700	„		
	5	0·500	—	0·500	7	4,500	not.		
	6	1·274	—	1·274	7½	4,700	in.		
	7	0·090	—	0·090	2½	4,820	„		
	8	0·310	0·310	—	4	6,300	„		
	9	0·469	0·385	0·084	4½	6,200	not.		
	10	0·110	0·110	—	—	5,900	in.		
	11	0·684	0·684	—	5	6,300	not.		
	12	0·521	0·496	0·025	9	4,820	„	Scharlée and Moens.	
	13	0·032	—	—	4	6,830	in.		
	14	0·306	0·288	—	8	6,265	„		
	15	0·314	0·283	0·018	8	8,330	not.		
	16	0·175	0·175	0·031	7	6,260	„		
	17	2·378	1·183	1·195	9½	4,400	„		
	18	0·444	0·189	0·255	9	4,400	„		
	19	0·300	0·250	0·050	7	6,260	„	Junghuhn.	There is a sort of Chinchona which Junghuhn terms a *C. Calisaya*, but which evidently is a species between the latter and the *C. Pahudiana*. In appearance it much resembles the last-named tree, so that it may be—and probably has been—easily mistaken for it. This sort of Chinchona contains more alkaloid than the *C. Pahudiana*, but less than the *C. Calisaya*. The plantations contain about 12,000 trees of the species in question of a robust appearance and of speedy and profitable development.
	20	1·052	0·352	0·700	9	4,820	„		
	21	0·710	0·220	0·490	9½	4,400	„		
	22	0·537	0·387	0·150	9	4,400	„		
	23	3·025	1·525	1·500	10	4,600	in.		
	24	0·512	0·437	0·075	5	6,260	not.		
	25	0·440	0·330	0·110	8	6,260	„	Mülder.	
	26	1·200	0·500	0·700	10	4,600	in.		
	27	0·500	0·300	0·200	10	4,400	not.		
	28	2·200	0·900	1·300	8	4,600	in.		
	29	2·000	0·800	1·200	8	—	„		
Lancifolia.	1	4·130	2·300	4·830	4	4,200	Moderate shade.	De Vry, Junghuhn, Scharleé, and Moens.	In the roots of the younger plants a considerable quantity of alkaloid is always discoverable, more than one per cent. (according to Maier) in roots of 1½ year old *C. Pahudiana*.
	2	4·925	3·375	1·550	7	6,760			
	3	5·925	4·660	1·265	—	6,260			
	4	2·692	1·514	1·178	—	6,260			

* *See* Supplement.

Table C.—Results of the Chemical Analyses of various kinds of Chinchona Barks—*continued.*

Chinchona.	No.	Amount of Alkaloid.	Quinine and analogous Substances.	Chinchonine and analogous Substances.	Age (in Years).	Site. Elevation above the sea.	Growing in Shade or not.	Examined by.	Remarks.
						Feet.			
Calisaya.	1	1·750	—	—	6	4,500	not.	De Vry.	A smaller quantity is also to be met with in the Chinchona leaves. The barks subjected to examination were not deprived of their outward covering or epidermis, so that the per-centage was less than if only pure bark had been analysed. A fresh and considerable quantity of samples of bark are now in course of preparation, in order to be tested at Weltevreden. The results of the analyses will throw light on many questions. No. 9 to 16 (inclusive) and No. 21 refer to bark obtained from the branches. No. 29 is bark taken from the root. No. 2 was destroyed by a rhinoceros and found in that state in the forest.
	2	5·000	3·535	1·465	6½	4,500	„		
	3	1·040	—	—	6⅞	4,600	in.		
	4	0·648	—	—	7	4,820	„		
	5	2·941	2·553	0·388	7	4,600	„		
	6	1·770	1·515	0·255	7½	4,600	„		
	7	3·443	3·278	0·165	3½	4,500	not.		
	8	0·200	—	—	—	5,800	in.		
	9	1·942	1·682	0·260	—	4,000	not.		
	10	1·416	1·070	0·346	—	4,700	in.		
	11	1·190	0·566	0·624	—	5,600	„		
	12	2·255	1·219	1·036	—	5,800	„		
	13	2·760	1·628	1·132	—	5,800	„		
	14	0·055	—	—	—	5,600	„		
	15	1·046	0·970	0·076	—	4,500	not.		
	16	2·600	1·620	0·980	—	4,500	„		
	17	4·310	—	—	5	4,400	„		
	18	3·900	—	—	—	4,000	„		
	19	5·717	4·741	0·976	10	4,000	„	Scharlée, and Moens.	
	20	5·137	3·875	1·262	10	4,000	„	Junghuhn.	
	21	0·860	0·360	0·500	9¼	4,600	in.		
	22	3·700	2·100	1·610	10	4,600	„	Mülder.	
	23	2·100	1·400	0·700	10	4,600	„		
	24	1·324	0·919	0·405	5	4,800	not.		
	25	0·647	0·502	0·055	5	4,800	„	Maier and Moens.	
	26	1·138	0·772	0·365	5	4,800	„		
	27	3·676	3·463	0·213	6	4,800	„		
	28	0·924	0·559	0·365	6	4,800	„		
	29	4,430	4·298	0·132	6	4,800	„		
Succirubra.	1	2·884	1·693	1·191	4	5,000	in.		
	2	1·310	0·776	0·534	7	5,000	„		

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

Digitized with financial assistance from the
Government of Maharashtra
on 18 July, 2018